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FIFTEENTH ANNUAL REPORT

OF THE

North Dakota Agricultural Experiment Station

AGRICULTURAL COLLEGE, NORTH DAKOTA

To the Governor of North Dakota

PART I

BISMARCK, N. D.
TRIBUNE, STATE PRINTERS AND BINDERS.
1905.

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LETTER OF TRANSMITTAL

AGRICULTURAL COLLEGE, N. D.,
February 1, 1905.

Hon. E. Y. Sarles, Governor of the State of North Dakota:

SIR: As required by act of congress approved March 2, 1887, I hereby submit the fifteenth annual report of the North Dakota Experiment Station for the year ending February 1, 1905, together with a financial statement of receipts and disbursements, as required by law, for the government fiscal year ending June 30, 1904.

Very respectfully yours,

ALEX. STERN,
President Board of Trustees.

REPORT

To the Board of Trustees of the North Dakota Agricultural College and Experiment Station:

GENTLEMEN: I have the honor to submit to you the fifteenth annual report of the North Dakota Government Experiment Station.

The following bulletins were published during the year:

No. 59. Trees and Fruit in North Dakota.
No. 60. Analysis of Formaldehyde Sold in North Dakota.
No. 61. Scabies in Sheep and Cattle and Mange in Horses.
No. 62. Weed Studies.
1. Buried Weed Seed.
2. Notes on French Weed.
3. Quack Grass.
4. Canada Thistle and Sow Thistle.
No. 63. Adulterated Food Products and Food Studies.

FARMERS' INSTITUTES.

Since the fourteenth annual report was published farmers' institutes were held at Hillsboro, Thompson, Emerado, Lakota,, Crary, Cando, Knox, Towner, Granville, Mohall, Glenburn, Ray, Stanley, Bottineau, Larimore, Dwight, Barney, Milnor, Cogswell, Fairmount, Havana, Ellendale, Walcott, Fargo, Bathgate, Hensel, Hannah, Park River, New Rockford, Sheyenne, Oberon, Leeds, Rugby, Berthold, Ray, Willow City, Churchs Ferry, Portland, Hunter, Kindred, Walcott, Aneta, Hope, Dickinson, Glen Ullin, New Salem, Edgeley, LaMoure, Lisbon, Michigan City, Edmore, Starkweather, Rolla.

Many of these were one-day meetings, which in the main were well attended and satisfactory to the communities in which they were held. It is possible that the above list includes some institutes held the previous year.

INSTITUTE CORPS.

The following institute speakers were engaged at different times during the year covered by this report:

T. A. Hoverstad, Crookston, Minn.

E. G. Schollander, Agricultural College, N. D.
Jas. Austin, Hannah, N. D.
H. L. Bolley, Agricultural College, N. D.
Mrs. V. R. Wilcox, Benson, Minn.
A. K. Bush, Dover, Minn.
W. F. Styles, Lake Mills, Wis.
W. W. P. McConnell, St. Paul, Minn.

During the past year the interest in farmers' institutes has grown and the attendance at the meetings improved. They are no longer an experiment. The farmers demand them. While the institute corps is not necessarily composed of members of the experiment station staff, it is very desirable that a close relationship be maintained between the experiment station and farmers' institutes. Much of the data obtained at the station and the results of station research can be profitably disseminated at farmers' institutes. It is also desirable that members of the station staff come in direct contact with farmers in different sections of the state, that they may become acquainted with its local conditions to the end that the work of the experiment station may be better adapted to the varying conditions that exist in different parts of the state.

The sum of money appropriated by the legislative assembly of 1903, while reasonably liberal, was not sufficient to meet the demands made upon it. I am of the opinion that a much larger sum of money can be profitably expended for enlarging the work of farmers' institutes. An agricultural state is justified in using every means at its command to foster and improve its paramount industry.

NEW BUILDINGS.

The experiment station is in need of a seed house and root cellar for housing grain and vegetables where they will be safe from the ravages of mice, rats and winter. The breeding of plants is an important work of the station, a work for which the Department of Agriculture, Washington, D. C., gives independent aid, but much of the good work accomplished is lost by grains becoming mixed by vermin, and potatoes and other vegetables freezing in winter. Much valuable time and money is lost each year for want of a suitable building and a suitable cellar for the safe keeping of grains and vegetables.

A new sheep barn should also be built and the present combination sheep and pig barn used exclusively for pigs. This would enable the live stock department to procure a greater number of breeds of both sheep and pigs for use in stock judging, and for making comparative feeding experiments.

The poultry house, together with a number of high bred fowls, was destroyed by fire last December. A new building will be

erected in the spring, which will be made to conform to the best models for housing poultry.

STATE AID.

It is desirable that the state render the experiment station substantial financial aid. Better live stock should be purchased for the college farm, and a larger number of bulletins should be published each year. The research work should also be extended on many new, but important lines. Contagious animal diseases offer an inviting field for investigation and one of great and growing importance to the live stock interests of the state.

Extensive experiments should be made with dairy cows, their feed and care, and the proper handling of milk and cream, with a view of encouraging the dairy industry. Large attention should also be given to poultry to determine what breeds are best adapted to North Dakota conditions, and the housing, feed and care that will make them most profitable for the farmer.

Comparative experiments in a field way should be carried on with farmers in different sections of the state. These should be inaugurated with a view of testing different methods of tillage, destruction of weeds, adaptation of farm machinery under varying soil conditions, and for the distribution of new and improved varieties of grasses and grains. Co-operative experiments should also be made where surface irrigation is feasible, to determine the value of wind mills for supplying water on limited areas.

Crop rotaton is being worked out satisfactorily on the home station and on the Edgeley substation, but conditions of soil vary so widely throughout the state that until the station is able to co-operate directly with farmers the best results cannot be determined. Without state aid the work of experimenting must be confined to the stations and restricted rather than enlarged.

PLANT DISEASES.

The department of botany is devoting its energies to such problems as rust, smuts, blight in trees and vegetables, flax-sick soil, etc., but is badly handicapped for want of greenhouses to prosecute important investigations throughout the fall, winter, and spring months.

A careful perusal of the reports of the several departments embodied in the fifteenth annual report will convince the most skeptical that the work of the experiment station is conducted along broad, practical and intelligent lines, and that each department is striving industriously how to best promote the agricultural interests of the state.

THE EDGELEY SUBSTATION.

Appended to this report is the report of the work accomplished at the Edgeley substation during the past year. Although but two years old the results obtained fully justify its existence, notwithstanding a considerable portion of the annual appropriations had to be used for the erection of necessary buildings, and for the purchase of farm machinery, teams, fencing, trees, etc. The substation is still in need of a modern farm house, the building of which will, however, strain its resources for several years to come. After that the work of the substation will be greatly augmented and new and important lines of investigation inaugurated.

J. H. WORST,
Director.

CHEMICAL DEPARTMENT

To J. H. Worst, Director:

DEAR SIR: The present is my fifteenth annual report as chemist of the North Dakota Government Agricultural Experiment Station for the year 1904.

The work in this department has been along the same lines as in previous years, namely, examination of waters for the citizens of the state, a continued study of soils, meteorological studies, and an investigation to determine why formaldehyde was not effective in destroying wheat smut, and in this connection 221 samples were analyzed to determine the percentage strength. We have in addition to the above examined during the past eighteen months more than 3,500 samples of foods, beverages, etc., to determine to what extent they were adulterated or fraud practiced in the preparation and sale of our common food products. We have also continued the co-operative experiments with the Department of Agriculture in the selection and breeding of wheat and corn of high protein content.

The amount of correspondence during the past year has been exceptionally large, as will be indicated from the fact that 2,314 letters have been written and over 2,200 postal card notices sent out. This means an average of seven and four-tenths letters each working day for an entire year and seven postal card notices. It means 2,381 pages of copy book as record of these letters. To answer many of the questions asked requires considerable research work or the looking up of data, or the chemical analysis of a product like milk, water, clays, foods, etc.

With regard to our facilities for doing station work I can do no better than to quote from my last annual report the following:

"The department has been very seriously hampered for the lack of proper room or facilities for conducting the work of the station and college. At times we have felt that our work is far from being creditable to the institution. When one examines the conditions under which we have been forced to carry out our work and experiments, one may well wonder how anything could be accomplished."

I quote from my last annual report on this point as follows:

"I do not know of another experiment station department of chemistry in this country as poorly housed and provided for doing work as our own, and this, too, in one of the states almost purely agricultural."

SUMMARIES OF TEMPERATURES, RAINFALLS AND SUNSHINES.

The record of meteorological data begins with 1892 and has been continuous since. The report for each year has been published in the preceding annual reports, and a few general summaries have been given in some of the former reports. For the present year we have the following data:

TEMPERATURE AND RAINFALL, 1904.

Month	Mean	Max.	Min.	Rainfall
January	1.2	36	—39	.13
February	—3.1	41	—30	.45
March	19.1	55	—17	.95
April	36.6	78	14	2.74
May	55.1	83	27	1.47
June	62.4	88	33	3.83
July	62.4	90	37	2.83
August	64.0	91	38	.69
September	54.6	87	28	3.49
October	45.9	72	21	2.30
November	34.8	71	1	.01
December	11.6	45	—19	1.37
Average and total	37.05	69.75	7.83	20.26

The mean temperature for January and February was considerably lower than for the same period in 1903, but for November the temperature averaged 11.20 warmer than for the previous year. This makes the mean temperature for 1904 but little different from that of 1903. March and April were cold months making a backward spring.

The rainfall for 1904 was very nearly the average for the past thirteen years, that is 20.26 inches as compared with 20.83 inches for the whole period. The rainfall for August was the lowest for the period of thirteen years.

The annual rainfall since 1892 is shown in the following:

	1892	1893	1894	1895	1896	1897	1898
Rainfall—inches	20.73	16.17	18.72	16.05	21.77	22.50	16.36

	1899	1900	1901	1902	1903	1904
Rainfall—inches	21.20	25.54	25.68	23.16	23.81	20.26

This gives an average annual rainfall of 20.83 inches for the thirteen years, with a minimum of 16.05 in 1895 and a maximum of 25.68 in 1901.

The rainfall by months for the past ten years is shown in the following table:

RAINFALL BY MONTHS.

Month	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904
January	.36	1.90	.35	.06	.29	.45	.05	.18	.83	.13
February	.12	.06	.77	.10	.29	.54	.11	.34	.45	.45
March	0	.48	.96	.34	1.58	1.23	1.31	1.42	.42	.95
April	1.36	3.64	.89	.88	1.39	1.82	1.76	2.30	1.34	2.74
May	1.62	4.70	.74	4.15	4.22	.81	.98	4.25	2.78	1.47
June	4.81	2.41	7.10	2.25	3.44	2.11	5.91	3.07	.56	3.83
July	3.24	.91	8.24	2.59	2.78	3.91	7.29	2.54	2.62	2.83
August	1.59	2.17	.77	2.84	3.71	8.28	1.59	2.95	4.61	.69
September ..	1.55	2.58	.67	1.23	1.24	3.27	2.57	.58	5.61	3.49
October	.14	1.96	1.81	1.62	1.67	2.80	3.83	5.17	2.49	2.30
November .. .	1.16	.70	.25	.08	.27	.20	0	.19	.10	.01
December	.10	.26	.04	.22	.33	.12	.28	.17	1.00	1.37
Summary.	16.05	21.77	22.50	16.36	21.21	25.54	25.68	23.16	23.81	20.26

A study of the data presented shows much of interest to the agriculturalists of the state. The rainfall is very largely during the growing period, and very little during the winter months. The total rainfall or snow calculated as rain for the five months November to April averages less than two inches.

MONTHLY RECORD OF SUNSHINE.

The record of sunshine is taken by means of a Friez photographic recorder, but no correction has been made for unrecorded early morning and evening sunshine which amounts to not less than 12 per cent.

SUNSHINE RECORDED—1904.

Month	Total hours		Hours daily mean		Percentage possible sunshine
	Possible	Recorded	Possible	Recorded	
January	.....	.....	.....	.....	.....
February	287.1	104.4	9.9	3.6	34.3
March	380.2	120.0	12.2	3.8	32.4
April	404.3	146.4	13.47	4.88	35.51
May	466.3	204.8	15.04	6.6	46.5
June	475.0	193.3	15.8	6.44	44.5
July	480.2	277.0	15.49	8.93	58.65
August	441.8	249.4	14.2	8.04	56.17
September	378.3	66.6	12.61	2.22	17.80
October	337.6	120.6	10.89	3.87	35.98
November	281.6	131.7	9.38	4.39	42.56
December	267.1	67.9	8.61	2.19	25.17
Total or mean	4,199.5	1,722.1	12.50	4.99	39.04

In the next table is shown the per cent of actual recorded sunshine for the past six years.

PER CENT OF SUNSHINE BY MONTH.

Month	1899	1900	1901	1902	1903	1904
January	31.3	37.8	40.0	44.4	29.83	
February	51.9	50.0	50.2	46.0	60.19	34.3
March	55.5	44.9	48.9	36.7	29.76	32.4
April	61.6	65.8	42.7	51.3	46.20	35.51
May	39.1	68.2	64.8	48.6	51.29	46.5
June	52.2	55.1	40.4	49.6	56.36	45.5
July	63.7	56.1	53.5	60.5	46.32	58.65
August	42.8	36.4	57.9	46.9	.....	67.17
September	58.7	38.9	55.8	51.4	37.47	17.80
October	29.4	31.2	57.7	43.0	46.23	35.98
November	39.3	36.3	42.8	29.3	29.3	42.56
December	47.7	30.2	22.3	32.1	20.1	25.17
Mean	48.8	47.1	49.43	45.2	41.18	39.04

The compiled data for the same period is shown in the adjoining table where we have shown the total hours of recorded sunshine, the daily mean hours of recorded sunshine and the per centage of sunshine.

	1899	1900	1901	1902	1903	1904
Total hours recorded.....	2,166.85	2,116.5	2,203.7	2,034.8	1,813.9*	1,722.1†
Daily mean hours recorded.....	5.97	5.70	6.05	5.61	5.22	4.99
Percentage of sunshine.....	48.8	47.1	49.43	45.2	41.18	39.03

*The record for 1903 is deficient for the entire month of August. The instrument was tampered with and the record destroyed.

†The record for 1904 is deficient for the month of January. The record was lost by the instrument being tampered with.

There has been since 1901 a regular decrease in the per cent of sunshine recorded from 49.43 per cent to 39.04 per cent. There has been also an increase in cloudy weather but a decrease in water evaporation from a water surface and generally an increase in rainfall.

EVAPORATION FROM A WATER SURFACE.

In 1902 and again in 1903 we published the daily evaporation of water from a water surface. In this work distilled water was employed and the experiment was conducted as outlined in the thirteenth annual report on page 20.

The evaporation for the same period for 1904 is given in the accompanying table.

Date	May	June	July	August	Septemb'r
1	.40	.11	.20	.20	.10
2	.20	.03	.30	.30	.20
3	.20	.30	.21	.17	.14
4	.20	.24	.45	.30	.10
5	.20	.01	.20	.20	.22
6	.20	.10	.20	.30	.20
7	.23	.20	.30	.30	.11
8	.17	.0	.20	.01	.10
9	.12	.30	.37	.20	.20
10	.22	.10	.0	.40	?
11	.10	.30	.50	.20	.0
12	.20	.10	?	.10	?
13	.10	?	.34	.40	.03
14	.18	?	.30	.70	?
15	.13	.30	.40	.50	.10
16	.23	.25	.30	.29	.0
17	.10	.25	.28	?	.20
18	.30	.30	.30	.50	.10
19	.30	.23	.20	.30	.10
20	.30	.21	.31	.40	.10
21	.20	.20	.10	lost	.10
22	.20	.21	.30	lost	.07
23	.07	.16	.40	.10	.01
24	.21	.10	.21	.30	?
25	.10	.20	.21	.40	?
26	.21	.20	.30	.70	.05
27	.20	.40	.30	.50	.02
28	.30	.20	.20	.40	.02
29	.20	.10	.06	.03	.01
30	.20	.30	.30	.0	.01
31	.43	...	.31	.10	....
Total	6.40	5.40	8.05	8.30	2.29
Daily mean	.206	.193	.268	.296	.091

The total amount of water evaporated for the five months, May to September inclusive, from a water surface of 6.09 inches per month or a daily average of .215 inches. This is considerable less than for the preceding.

The summary for the past three years is shown by months in the following table:

INCHES OF EVAPORATION .

Month	1902	1903	1904
May	6.48	4.30	6.40
June	5.75	8.69	5.40
July	4.77	13.26	8.05
August	6.62	12.07	8.30
September	4.50	3.55	2.29
Total	28.12	41.87	30.44

The above shows a wide range of difference for the three seasons, and the data, when examined in connection with other meteorological data and soil studies, furnishes much instructive data to be worked up when the records are more complete.

The rainfall for the same period by months was as follows:

INCHES OF RAINFALL.

Month	1902	1903	1904
May	4.25	2.78	1.47
June	3.97	.56	3.83
July	2.54	2.62	2.83
August	2.95	4.61	.69
September	.61	5.61	3.49
Total	14.32	16.18	12.30

In 1902 the evaporation was 1.96 times the rainfall for the same period in 1903. In 1903 it was 2.58 times as great, and in 1904 it was 2.47 times as great. Or, in other words, the evaporation from a water surface is from 2 to 2.5 times the amount of the rainfall for the months under consideration. The evaporation from soil surface needs to be more fully studied before any comparison can be safely made for North Dakota conditions.

A point that is clearly evident is the necessity for conserving soil moisture as largely as possible for the use of the plants in a region where the evaporation is so much greater than the rainfall during the growing period.

ANALYSIS OF FORMALDEHYDE SOLD IN NORTH DAKOTA.

In 1903 there was considerable complaint among farmers in this state that the formaldehyde method of treating wheat for the purpose of destroying smut was not always effective. Either the method was at fault or the formaldehyde was not of standard strength, and farmers became discouraged. To treat the entire seed wheat for a large North Dakota farm is an expensive process and in the fall to find there has been no improvement in the crop; that the loss from smut is heavy is a serious matter. The chemical department took up the matter but it was then too late to do very much. A few samples of formaldehyde were collected and analyzed to determine the per cent of actual formaldehyde present. From our analysis for 1903 I select a few where the results indicated the solutions to be weak in strength.

SAMPLES FROM—	PER CENT.
Knox	26.27
Moorhead	27.72
Casselton	28.90
Casselton	31.98

Our analysis for 1903 shows clearly that the formaldehyde sold was not always as claimed, a 40 per cent solution.

There were also further complaints that the amount sold by druggists, for a pound or a pint, was not always full measure and some of the bad results were to be attributed to this cause. The manufacturers and jobbers were inclined to blame the druggists for this weak condition and for the short weights.

The matter was taken up during the summer of 1903 with the manufacturers and jobbers and we were assured that in 1904 the formaldehyde should be of full strength. It was further intimated, by some of the manufacturers, that some irresponsible druggist might be diluting the bulk goods sold in carboys, so as to materially effect its strength, but this could only be in isolated instances and that we should not be too severe in our criticism until it could be clearly shown that the manufacturers and jobbers were at fault. The loss to the farmers of this state in 1903 amounted to thousands of dollars, caused by using weak formaldehyde and short measure. In many instances farmers who treated their seed wheat to destroy smut reported no improvement in the crop when harvested over that of the untreated wheat. Here, then, the farmers lost the cost of the material, cost of labor in treating the seed, suffered a loss of 10 to 20 per cent in yield and were obliged to sell for a lower grade than where the treatment had been successful. Naturally, the farmers felt that there was something wrong, either the formaldehyde was not of proper strength or that the method recommended for treating

the wheat is in practice a failure. For information and aid they have naturally turned to the Experiment Station for assistance in a matter of such vital importance It was decided, early in 1904, that we would undertake an investigation to determine where the real trouble lay and druggists were invited to send samples of formaldehyde for analysis. The most of the samples sent were in four, six, and eight-ounce bottles, but in a few cases the original bottle itself was sent with the instruction for treatment. Of these I shall speak later.

The commercial formaldehyde is supposed to be a 40 per cent solution and on this basis a method was worked out by Professor Bolley for treating grain for destroying smut. No genuine sample, to be of good strength, should be less than 38 per cent and when the analysis shows less than 37 per cent it cannot be recommended as suitable for use on the basis recommended for destroying smut. Experiments have demonstrated that too strong a solution will kill the wheat while a too weak solution does not kill the smut. The range, however, is sufficiently wide so that there is no danger where the formaldehyde is of normal strength of injuring the wheat or of failure to destroy the smut. So far as could be done, from the information furnished, we have grouped this formaldehyde according to the name of the manufacturers or jobbers who supplied the products as the names were furnished us by druggists.

The following samples were reported by druggists as having been purchased from Noyes Brothers & Cutler, St. Paul, Minnesota:

No.	Where from and Container	Per Cent
2	St. Paul, bottle	42.41
5	Willow City, bottle	39.83
6	Willow City, bottle	39.04
8	Osnabrock, carboy	38.70
11	Brazil, carboy	38.93
13	Havana, carboy	37.91
29	Willow City, carboy	40.08
30	Willow City, carboy	40.02
34	Finley, carboy	39.88
37	Minot, carboy	39.15
41	Alice, carboy	39.71
43	Maddock, barrel	39.37
49	Washburn, barrel	38.81
51	Bisbee, barrel	40.84
60	Bisbee, barrel	40.81
63	Berthold, barrel	37.80
66	Sheldon, barrel	39.09
72	Minot, barrel	39.60
73	Judson, barrel	38.81
76	Berwick, carboy	40.27

No.	Where from and Container	Per Cent
82	Williston, carboy	38.47
84	Casselton, carboy	40.50
89	Souris, carboy	40.05
90	Abercrombie, carboy	38.36
97	Jamestown, carboy	40.16
98	Jamestown, carboy	39.09
100	Oakes, carboy	40.83
101	Fessenden, bottle	41.23
107	Wheatland, bottle	40.39
119	Hillsboro, bottle	40.95
135	Bathgate, bottle	39.82
138	Berthold, bottle	39.88
140	Rolla, bottle	40.89
147	Langsford, bottle	40.78
156	Langdon, bottle	39.65
157	Leal, bottle	39.37
165	Fargo, carboy	41.34
177	Ardoch, carboy	41.40
184	Havana, carboy	40.95
190	Fessenden, carboy	36.84
198	Fessenden, carboy	36.78
	Average of forty-one samples	39.72

For forty-one samples then we have a mean average of 39.72 per cent, a maximum of 42.41 per cent and a minimum of 36.78 and this was the only sample which fell as low as 37 per cent.

I next compile the results for the analysis of all samples which were reported as having been purchased from Lyman-Eliel Drug Co. of Minneapolis, Minn.:

No.	Where from and Container	Per Cent
14	Fargo, carboy	37.80
16	Fargo, carboy	38.81
23	Oakes, carboy	36.90
38	Walcott, carboy	38.25
44	Fairmont, carboy	37.24
62	Milton, carboy	38.47
67	Sheldon, carboy	39.77
68	St. Thomas, carboy	39.43
74	Larimore, carboy	39.26
81	Devils Lake, carboy	38.14
86	Inkster, carboy	38.37
94	Pleasant Lake, carboy	37.97
95	Hatton, carboy	34.87
102	Fessenden, bottle	39.26

No.	Where from and Container	Per Cent
108	Neche, bottle	39.32
112	Willow City, bottle	38.86
117	Lakota, bottle	38.92
121	Courtenay, bottle	38.81
122	Casselton, bottle	39.04
124	Hatton, bottle	38.25
128	Thompson, bottle	39.82
136	Bathgate, bottle	39.94
137	Oakes, bottle	39.71
139	Donnybrook, bottle	39.82
161	Kensal, bottle	39.76
166	Berwick, bottle	37.96
167	Oakes, bottle	38.92
168	Grandin, bottle	41.40
169	Grandin, bottle	37.06
170	Berlin, bottle	39.08
171	Dazey, bottle	39.49
172	McCanna, bottle	40.72
183	Jamestown, bottle	39.88
213	Minot, bottle	39.60
	Average of thirty-four samples	38.82

Here we have an average of 38.82 per cent of formaldehyde in thirty-four samples examined, a maximum 41.40 per cent and a minimum of 34.87 per cent. These results do not materially differ from the preceding.

The following samples were reported by druggists as having been purchased from the Leithead Drug Co., of Duluth:

(In justice to the Leithead Drug Co. it should be stated that they report having purchased their goods from the Dr. Leininger Chemical Co., of Chicago, with a guarantee that it was to be 40 per cent in strength. They further submit their correspondence to confirm their statements.)

No.	Where from and Container	Per Cent
7	Courtenay, carboy	25.42
10	Walcott, carboy	33.86
21	Taylor, bottles	33.19
31	Duluth, carboy	27.45
32	Duluth, carboy	33.99
35	Casselton, carboy	38.13
47	Cooperstown, 1904, carboy	33.86
48	Cooperstown, 1903, carboy	33.75
52	Cooperstown, two years old, carboy	38.81
53	Grand Forks, carboy	39.15

No.	Where from and Container	Per Cent
69	Minnewaukan, carboy	35.71
79	Aneta, carboy (old stock)	39.82
77	Donnybrook, carboy	29.59
91	Bowbells, carboy	28.29
110	Youngstown, carboy	34.65
162	Davenport, carboy	38.81
186	Gilby, 1903 stock, carboy	34.42
199	Fessenden, carboy	32.91
203	Starkweather, carboy	29.14
	Average for nineteen samples	33.75

Here then from nineteen samples of formaldehyde reported as having been purchased from the Leithead Drug Co. we have an average of only 33.75 per cent, a minimum of 25.42 per cent and a maximum of 39.82 per cent, a product so widely varying in strength as to be unfit for the use for the purpose for which it was being sold.

The next table shows the results from analysis made of samples purchased from the Dr. Leininger Chemical Co., Chicago:

No.	Where from and Container	Per Cent
1	Chicago, bottle	39.37
3	Wyndmere, carboy	33.30
4	Fargo, bottle	37.91
4B	Fargo, bottle	38.47
9	Milton, bottle	21.60
18	Neche, bottle	35.21
19	Oakes, bottle	30.37
20	Grafton, carboy	37.35
24	Oakes, carboy	30.71
25	Fargo, A carboy	37.68
25	Fargo, B carboy	36.78
25	Fargo, C carboy	37.12
26	Fargo, A carboy	36.45
26	Fargo, B carboy	32.85
26	Fargo, C carboy	33.07
28	Hillsboro, carboy	38.19
33	Duluth, bottle	31.16
36	Buffalo, bottle	33.75
50	Starkweather, bottle	28.46
56	Neche, bottle	36.73
58	Sawyer, bottle	31.72
59	Chicago, bottle	34.54
64	Edgeley, bottle	39.04
71	Minot, bottle	35.38
78	New Rockford, bottle	38.70

No.	Where from and Container	Per Cent
85	Erie, bottle	23.06
92	Grandin, carboy	37.01
93	Pingree, carboy	38.36
96	Portal, carboy	31.31
103	Balfour, carboy	37.63
104	Esmond, bottle	36.45
113	Bisbee, bottle	35.66
118	Westhope, bottle	38.08
123	Westhope, bottle	36.34
142	Oriska, bottle	38.41
146	Langsford, bottle	39.03
174	Minot, bottle	35.77
175	Church's Ferry (1903 stock), bottle	35.21
176	Harvey, bottle	30.94
197	Barlow, bottle	38.92
201	Russell, bottle	38.64
	Average of forty-one samples	35.12

For forty-one samples of formaldehyde traced back to this firm we find an average of 35.12 per cent, a minimum of 21.60 per cent. and a maximum of 39.37 per cent. There is no question in my mind but what these parties are knowingly guilty of furnishing a product which, to say the least, was known to be adulterated. One year previous their attention was called to the condition of the product being sold by this firm and we had reasons to expect that such a condition should not be again repeated in 1904. The product from a house having such wide range should not be tolerated by the public, who are most seriously injured financially by the use of such goods.

In the early part of 1904 the Leininger Chemical Co. sent a sample bottle of their formaldehyde with the assurance that this would fairly represent the product which they would send to the state. This sample was found to contain 39.37 per cent of formaldehyde.

Four samples of formaldehyde were received and reported as having been purchased from the Jewett Drug Co., Aberdeen, South Dakota. On analyses of these we have the following:

No.	Where from and Container	Per Cent
45	Medina, bottle	28.35
46	Medina, bottle	28.35
179	Drake, bottle	39.37
193	Fessenden, bulk	38.75
	Averaage for four samples	33.71

The Jewett Drug Co. write me that their formaldehyde was purchased from the Dr. Geo. Leininger Chemical Co., Chicago.

The history of a large number of samples examined could not be secured. In some instances the samples were sent by farmers and in other cases the druggists or other retailer failed to furnish the desired data. We present below the results:

No.	Where from and Container	Per Cent
12	Surry, bottle	38.58
15	Fargo, bottle	37.35
17	Fessenden, bottle	31.38
27	Crary, bottle	40.61
39	Hillsboro, bottle	39.71
40	Edgeley, bottle	39.09
54	Litchville, bottle	29.02
55	Bottineau, bottle	38.35
57	Bismarck, bottle	39.32
61	Dazey, bottle	39.59
65	Sheyenne, bottle	31.78
75	Kenmare, bottle	38.36
79	Fingal, bottle	27.45
80	Fingal, bottle	35.66
83	Buffalo, bottle	34.31
87	Donnybrook, bottle	29.41
88	Barlow, bottle	38.59
99	Portland, bottle	40.55
105	Surry, bottle	39.93
106	Esmond, bottle	36.28
111	Knox, bottle	40.95
114	Underwood, bottle	39.15
115	Park River, bottle	41.23
116	Langdon, bottle	38.87
120	Carrington, bottle	40.32
125	Souris, bottle	39.65
126	Beyrout, bottle	38.02
127	Jamestown, bottle	41.23
129	Eric, bottle	30.48
130	Jamestown, bottle	39.15
131	Berlin, bottle	29.47
132	Berlin, bottle	40.27
133	Denbigh, bottle	38.70
134	Spiritwood, bottle	38.81
141	Cando, bottle	39.09
143	Barlow, bottle	32.96
144	Milnor, bottle	40.50
145	Milnor, bottle	39.82
148	Buchanan, bottle	41.06
149	Berlin, bottle	29.30
150	Drake, bottle	21.71

No.	Where from and Container	Per Cent
151	Oakes, bottle	39.32
152	Kenmare, bottle	38.02
153	Goodrich, bottle	37.18
154	Langdon, bottle	39.13
155	Hecla, bottle	32.96
158	Minneapolis, bottle	39.71
159	Cathay, bottle	40.83
160	Bottineau, bottle	37.24
163	Devils Lake, bottle	36.11
164	Fort Ransom, bottle	39.31
178	Rugby, bottle	39.77
180	Souris, bottle	39.77
181	Souris, bottle	38.53
182	Fairmount, bottle	39.15
185	Melville, bottle	39.26
187	Fullerton, bottle	38.31
188	Leeds, bottle	41.12
189	Larimore, bottle	38.25
191	Mantador, bottle	37.12
194	Berwick, bottle	40.84
195	Cathay, bottle	34.25
196	Island Lake, bottle	41.28
200	Grand Harbor, bottle	14.17
202	Oakes, bottle	41.51
204	Drake, bottle	39.21
205	Fisher, bottle	31.16
206	Larimore, bottle	39.32
207	Glasston, bottle	38.02
208	Drake, bottle	39.60
209	Russell, bottle	39.82
210	Russell, bottle	38.70
211	Heaton, bottle	41.28
212	McCanna, bottle	39.99
214	Minot, bottle	39.43
215	Leeds, bottle	37.57
216	Hoffland, bottle	40.22
217	Hoople, bottle	37.57
218	Penn, bottle	41.00
219	Wagar, bottle	40.27
220	Burkett, bottle	37.80
	Average of eighty-one samples	37.40

For eighty-one samples examined we have an average of 37.40 per cent, a range from 14.17 per cent for the minimum to 41.28 per cent as the maximum.

From the data presented we believe it is not difficult to trace the weak or adulterated samples of formaldehyde heretofore sold in the state to its source. It is useless for interested parties to further try to throw the blame on the retailers for sealed samples of the goods in bottles direct from the manufacturers or possssors show a range too wide for permitting of such unwarranted assertions. There are several ways suggested as to why this particular product from one firm should have such a variable composition. We will leave this for others to determine. It is a fact, however, that the same firm sells largely the solid formaldehyde of commerce.

LOSS OF STRENGTH ON STANDING.

The claim has been put forth that on standing formaldehyde loses strength. Our analyses do not confirm this opinion. In the summer of 1903 we analyzed a sample of formaldehyde from a one-pound bottle labeled the Heyden Chemical Works, Garfield, N. J. This I found to contain 36.92 per cent. Since then the bottle has been standing in a warm place and recently it was re-examined with new solutions and by a different worker and the results reported were 36.68 per cent of formaldehyde, or but .24 of 1 per cent less than one year ago.

It is a well known fact that on evaporation formaldehyde solutions grow stronger rather than weaker. A single test made by distilling 200 cubic centimeters of solution containing 39.93 per cent of formaldehyde will suffice to illustrate. The per cent of formaldehyde found in each of the fifty cubic centimeters distilled over, also in the final residue, is shown below:

DISTILLED	PER CENT.
No. 1 50 c. c.	26.88
No. 2. 50 c. c.	30.60
No. 3. 50 c. c.	35.66
No. 4. Residue	54.22

The residue was on cooling in the flask converted into a solid product. Expressed in another form 200 cubic centimeters of formaldehyde contained 79.875 grams. There was then found in the several portions:

Distillate No. 1	13.44375 grams
Distillate No. 2	15.30000 grams
Distillate No. 3	17.83125 grams
Residue	27,11250 grams
Total	73.68750 grams

There was therefore a loss of 6.1875 grams, or this amount of formaldehyde was unaccounted for in the test.

The claim therefore made by certain manufacturers that the loss was due to evaporation is not borne out by the above test.

THE CARBOY SHOULD BE SHAKEN.

If the contents of a carboy in which considerable polymerization has taken place is not well shaken before the samples are taken then there may be considerable variation. The top portion will be found to be weaker than that below.

Bottles containing such samples were examined, first the clear liquid above and second the thicker portion from near the bottom of the bottle, with results as follows:

	No. 1.	No. 2.
Upper layer	32.74 per cent.	29.14 per cent.
Bottom layer	33.41 per cent.	31.16 per cent.

It is evident that there can be considerable variation between that drawn from the top of a carboy and that from the bottom. Druggists should see to it that the contents of carboys are well mixed, otherwise those who take from the first of the carboy may have a weak solution while the portion near the bottom of the carboy may be found too strong for safe use according to the methods prescribed for treating wheat to destroy smut.

SHORT WEIGHTS AND MEASURES.

Some of the difficulty is due to short weight and measures on the part of the druggists and others who have retailed the formaldehyde in the state. In some instances the carboy goods have been put up and sold in one and two-pound bottles. Old beer bottles are not infrequently used for this purpose and the contents sold for two pounds. The average beer bottle found in the state filled well up to the neck I find to hold about twenty-two ounces by volume or slightly less than one and one-half pounds. Even were the formaldehyde of average strength this would mean the same as a 32 per cent formaldehyde of full measure. The farmer employing this would be disappointed, for it would not make a solution strong enough to destroy smut.

Retailers in general are largely to blame for this condition, as they must know that full measure is not given. It means discrediting the method and loss of future business to the house selling this class of goods.

A bottle sent in by one of the leading drug houses labeled with directions for treating the wheat recommended that the contents of the bottle (one pound) was to be used in forty-five to fifty gallons of water. The bottle actually contained ten and one-half ounces by measure of 39.32 per cent solution of formaldehyde. The farmer who uses the product is sure to meet with disappointment. A two-pound bottle not so labeled but purchased by the farmer for this amount was found to contain twenty-three fluid ounces or 755 grams instead of 906 grams, which is 16 per cent short weight.

Another bottle supposed to contain one pound of formaldehyde was found to contain actually ten and five-tenths ounces instead

of sixteen. One prominent druggist recently admitted that more formaldehyde was frequently sold than purchased. There are but two ways in which this can be accounted for, short weights or measures and dilution. In either case the farmer is the loser.

CONFESSION OF A DRUGGIST.

In our efforts to get at the true inwardness of the trouble one prominent druggist gave us the following statement which may help to throw some light upon this mooted question:

"Many of the druggists of the state are dispensing a so called pound of formaldehyde in a Best tonic bottle and two pounds in a beer bottle. In other words less than sixteen fluid ounces is sold as a pound. * * * The result is plain. From the druggists' standpoint it means the discrediting of formaldehyde as a smut killer and a consequent falling off in sales. From the farmers' standpoint they suffer in at least three ways by this short measure:

"1. They pay for a pound and get ten ounces.

"2. They use ten ounces, believing it to be a pound, and get a solution of so weak a germicidal strength as to be nearly worthless and lose their labor in applying it.

"3. Much the most important of all, they lose in smut laden crops where they have paid their money and expended their energies, believing that they have complied with all conditions necessary to 'give formaldehyde a chance' and be rid of smut.

"Their natural and legitimate conclusions are that formaldehyde is no good. They have used it according to directions they think and failed to get results. From the papers and also from a circular received from you a few days ago I see you blame this failure to get results to under strength formaldehyde. Your conclusions are partly right, but I thought you ought to know the short weight fact (may be you do). Twelve ounces or three-fourths measure of 40 per cent means only practically the same as 30 per cent full measure and I don't believe the farmers add enough of these light weight pounds to make a solution of the desired strength to kill smut.

"Now I suggest that a circular be sent out to all the pharmacists of the state, telling them that an effort will be made to secure these light weight packages and if found the dispenser will be exposed unless he can prove that he has issued them in error.

"Now, professor, I expect you to accept this information in strictest confidence. Use your own judgment as to whether you act at all, or if so, what way. I request that no rumpus be made, but that all be first given a chance to get into line. Then make it disagreeable for the crooks if you like.

"I am not giving this information for any other reason than to make and keep formaldehyde popular as an efficient smut killer."

The above is a frank, straightforward statement of one phase of the trouble, but after all, as already pointed out, the chief difficulty is in the lack of uniformity in strength of this formaldehyde as sold in the state of North Dakota and presumably in the surrounding states.

I may mention another point of considerable importance to those who must buy largely of formaldehyde. The price per pound at which formaldehyde has been retailed in the state during the past year has ranged from about 30 cents to 60 cents per pound. Considering the cost of the product the highest figure seems to be exorbitant, and even the lower figure will permit a fair profit for the best makes now on the market.

CONCLUSIONS AND REMEDY.

1. Formaldehyde is largely adulterated by reducing its strength to a point where it is useless for treating wheat for smut.
2. Adulteration seems to be largely practiced by one firm of manufacturers, but large jobbers and drug houses handling such goods can not be held as blameless in this matter.
3. Some of the retailers have been guilty of selling short weight or measure, which is not more justifiable than the selling of an adulterated product.
4. The price at which formaldehyde has been retailed is out of proportion to its cost at wholesale.
5. The main reason why formaldehyde has not given more general satisfaction as a smut destroyer in wheat seems to be due to the fact that much of that sold has been weak and unfit for use.
6. Formaldehyde stored in carboys should be well mixed before drawing samples in order to secure a uniform product.
7. Formaldehyde does not grow weaker by evaporation as claimed by some manufacturers and jobbers.
8. The farmers, who are the principal consumers, need some protection or the use of formaldehyde for destroying smut in wheat will be discontinued.
9. A law similar to the fertilizer law should be enacted and strictly enforced. Such a law, properly enforced, would put a stop to the present practices and insures fair treatment for the farmer, who is made to suffer heavy loss while the state loses many thousands of dollars each year by smutted wheat, which is entirely unnecessary, since the farmers are doing their best to prevent this disease.

SECURITY STOCK FOOD.

The Security stock food (glutenized), manufactured by Security Stock Food Co., of Minneapolis, was sent in for analysis by Vaaler & Roppe, Flora, N. D.

Anaylsis of the product gave the following results:

	PER CENT.
Water	6.10
Ash	26.41
Fat (crude)	9.35
Crude fiber	5.89
Proteids, N x 6.25	11.00
Nitrogen-free extract	41.25
Total	100.00

An estimation of the chlorine in the water soluble part and calculation for sodium chloride (salt) gave 2.08 per cent.

A partial analysis of the ash gave the following per cent:

	PER CENT.
Sand, silica, etc.	2.00
Carbon	.22
Iron and alumina A1 2O3 and Fe2O3	18.24
Lime CaO	2.96
Magnesia MgO	.21
Soda and potash Na2O and K2O	38.40
Phosphoric acid P2O5	8.84
Sulphuric acid SO3	13.03

The statement that this product is glutenized is not borne out by the analysis, since the total proteid amount to only 11 per cent or much less than that in poor wheat bran. So far as the feeding value is concerned this product does not begin to compare with wheat bran.

Medicines are not to be generally recommended unless there is a demand for them. In such cases a competent veterinarian should be consulted.

BRIQUETTES.

Of late many attempts have been made to convert the lignite coal of this state into briquettes which would prove satisfactory as a fuel for household use. A sample of such briquettes was recently sent to the laboratory with the request that it be analyzed. Our results were as follows:

	PER CENT.
Water	1.67
Ash	7.83
Volatile carbon	40.04
Fixed carbon	50.46
Total	100.00
Total sulphur	.20
Heat calorics	13,790.

The above product was in excellent condition for use, and if the briquettes can be economically produced the lignite coal should become, as it undoubtedly will ,the fuel of the future in this state.

ANALYSIS OF INDIVIDUAL STALKS OF CORN.

In the last annual report, page 39, was given the analysis of a number of samples of corn. Two of these, Nos. 321, or plant 7, and 345, or plant 15, were used for seed again in 1903. The result of the analysis of the crop of that season is shown in the following table for water free substances:

	Plant	Ash	Fat	Proteids	Crude Fibre	Nitrogen-Free Extract
15	Stalk	6.80	1.89	9.06	24.40	57.85
15	Cob	3.05	.68	3.13	32.88	60.26
15	Kernel	2.07	3.67	14.00	2.41	77.85
7	Stalk	6.51	2.70	8.18	24.51	58.10
7	Cob	3.02	1.01	3.87	30.85	61.25
7	Kernel	2.20	3.77	14.50	2.81	76.72

A second set was also grown from the same seed and the results of the analysis are as below for the water free material:

	Plant	Ash	Fat	Proteids	Crude Fibre	Nitrogen-Free Extract
15	Stalk	5.77	3.87	8.56	26.36	55.44
15	Cob	3.62	1.92	5.56	31.37	57.53
15	Kernel	2.19	3.05	16.06	2.91	75.89
7	Stalk	7.46	2.45	9.56	24.62	55.91
7	Cob	3.85	1.84	5.75	30.37	58.99
7	Kernel	2.13	3.82	15.38	2.42	76.25

The two lots of corn from the same parent seed gave a crop quite different in proteid content. The albuminoids are high and such a corn would be superior of the average wheat as an animal food.

RECOMMENDATIONS AND ACKNOWLEDGMENTS.

Owing to the poor laboratory facilities and the amount of work required of this department many lines of experiments undertaken during the past year have not been completed and the analytical data is not yet available so that it is impossble for us to present a complete report at this time.

Many examinations of products have been made for farmers of the state, including at least 100 samples of water which are of interest more purely to the parties requesting the same, and until sufficient data has accumulated to make it wise to discuss the question

of the water supply of the state more comprehensively we shall not present the individual analyses.

I am greatly indebted to my assistants who have carefully performed the duties assigned them in this department.

In our present overcrowded room, poorly ventilated and ill adapted for the work, it is well nigh impossible to conduct satisfactorily lines of research work. To do investigational work in agricultural chemistry one must have experiments running four months, and space must be assigned where there will be no disturbance and experiments can go on unmolested. This we have not been able to do, and there are many problems in agriculture which might be studied with advantage to the state had we rooms adapted for the work. I trust that the present session of the legislature may take some action which will result in giving us a laboratory so that we may conduct the work of most importance to the agriculture of the state and as desired by the people of the state.

Respectfully submitted,

E. F. LADD,

Chemist.

DEPARTMENT OF BOTANY

To Director J. H. Worst:

SIR: As in preious years, I have tried to confine the work of botanical investigation to lines directly bearing upon practical farm operations with regular farm crops. Laboratory and greenhouse investigations are made upon such features of the work as will most further the studies in the field. The field studies are, in turn, worked upon so concise a plan that one is able to observe all essential variations from the normal, and to note the variations, if any, from the features observed in the laboratory investigations. To accomplish this aim the different experiments are conducted upon plots of various extent, from the growth of a few individual plants by hand methods to larger sized plots worked by regular farm machinery methods of culture. This later work allows us to give recommendations bearing upon the proper application of the principles studied to field work upon the farm.

CONDITIONS OF THE DEPARTMENT, ASSISTANTS AND EQUIPMENTS.

There has been one change in the working staff, of the deartment. Mr. Thomas Manns, having accepted a position as superintendent of schools in the Philippines, the position vacated has been filled by the appointment of Mr. F. J. Pritchard of Nebraska university. Mr. Pritchard is especially prepared to do work in plant pathology, and the work discontinued by Mr. Manns will be taken up with as slight loss of time as is possible under the circumstances.

The plant house so often asked for is still unbuilt. The absence of a good house of this type has always been a distinct handicap to the work of the department. I hope that the present legislature may make it possible to erect the house, so that our experimental work may go on under properly controlled conditions any month during the year. The summer season is so short that comparatively little may be accomplished in an experimental way with plants unless one has done many preliminary indoor tests and trials. Accuracy of outline is necessary before the larger general experiments should be undertaken.

EXPERIMENTS AND STUDIES UPON WHEAT.

Wheat continues to furnish a most interesting field for botanical and plant pathological studies. This year we have had under consideration the following features, with observations and investigations to determine:

1. Influence of smut upon the yield.
2. Influence of various methods of prevention of smut upon the yield.
3. Influence of age of seed upon the development of smut in the crop.
4. How to breed for immunity to smut.
5. How to breed for resistance or immunity to rust.
6. Conditions which favor rust infection and distruction of the crop.
7. What is the cause of "white belly," the white spots so commonly seen upon our hard wheats, causing the appearance of soft or starchy wheats.
8. What is the cause of "wheat blight" or "white heads?"

Progress of work has been made in all of these lines.

Wheat Blight.—Every year there is considerable complaint about "white heads," unfilled heads which turn white. This year, there was much complaint before rust became the all absorbing question. When the stools which bear white heads are examined it is found that the straw has ripened prematurely. Some have tried to lay the blame of this condition upon the grain louse (*Aphis*) or upon the work of the hessian fly, but the work of these is each easily recognized. The blighted wheat is also found to have many characteristics, particularly indicative of a real pathological nature. The roots die early and decay early, indicating that they are the first organs attacked. All other features of the trouble point to the same conclusions. So far our attempts at isolating a definite organism have not resulted in success. The wheat plant is a difficult one to grow under control conditions suitable to proper inoculation methods with the indefinite fungi. We have therefore not made much progress in establishing the real or specific cause of this trouble, but I think that I am safe in saying that we have to deal with a fungous disease which is transmitted by way of the soil, one of those soil troubles similar in its actions to wilt upon the flax plant. Certain weather and soil conditions undoubtedly greatly influence the development of the trouble. It does not seem to become general or widespread in its action except upon poorly drained areas and in fields in which wheat has been a rather continuous crop. At present I can make no recommendations concerning wheat blight, except to favor good drainage, seed disinfection and a wide seried rotation. I feel sure that eventually we shall prove satisfactorily that the loss in yield which is noticed in continuous cropping to wheat is as much due

to the introduction of destructive types of soil fungi as to soil exhaustion. Rotation, properly practiced, allows of a natural elimination of these pests which follow in the wake of a single crop agriculture.

The Cause of "White Belly" or "Starchy," Spotted Grains in Hard Wheats.—There have been many inquiries upon this subject from farmers in all parts of the Northwest. The hard red wheats of this region are especially characterized by the clear dark amber color of the substance of the grains. Grains of a lighter more starchy color are at once characterized by farmers and millers as "soft" wheats. I quote from a letter from the editor of The Farmers' Advocate and Home Magazine. This letter described the trouble pointedly and also raises the question of variation through cross fertilization.

Prof. H. L. Bolley, North Dakota Agricultural College:

DEAR SIR: Throughout western Canada no wheat is so generally grown as red fife, but, notwithstanding the efforts which are put forth continually by farmers to maintain its purity, there is a gradual and indeed a pronounced tendency for white grains to appear, even where the seed has been carefully hand picked. Cases are also reported where white specks have appeared on red kernels. With a view to throwing some light upon the subject we would be much pleased to have a short article from you, explaining to what extent cross fertilization takes place in wheat, and such other features as you may consider to have a bearing upon the question.

The trouble here described was more commonly noticed in the crop of 1903 than heretofore. Indeed, it was so common at points in the valley that many persons have remarked to the writer that the days of "hard" wheat are past in the valley; that the climate has changed and the soil has lost the capabilities to produce the old time hard, amber colored berries. We believe this is expressing groundless fear. Nature does not do things in such a spasmodic way.

Experiments to Determine Cause of "White Belly" in Wheat.—A number of typical samples have been placed under study in control to the normal grains.

(a) Germination Trials: Germination tests of white spot and white belly grains in contrast with best hard, amber grains of the same samples show no noticeable variation in the power to germinate, unless it be that the white grains start to swell and to germinate a shade sooner than the hard grains.

An example may be given. Scotch Fife furnished by Martin Hector, crop of 1903, grown near Wolverton. Fully one-third of the grains were white sided or white bellied. The crop had been properly harvested and was fairly well cured, so that the grains were but slightly injured in other ways.

The germination record of this sample gave the following results:

Red grains eighty-two strong, nine medium and nine weak.

White sided grains eighty-three strong, twelve medium and five weak.

(b) Microscopical Tests: Many razor sections were made from hard, amber colored grains and from the white or spotted grains. In treating these in preparation for section cutting it was observed that the white spot grains absorbed liquids or water more quickly than the amber colored grains, and in sectioning it was found that they were much less hard or horny. From the work done it was difficult to form a judgment as to the exact nature of the changes which have occurred. Further microchemical tests are needed to determine this point. As far as tested the studies do not indicate that any marked physical or chemical differences exist as to the normal contents. Some new experiments are planned to consider this point.

(c) Observations Upon Cross Fertilization: As to the point of crossing, it may be said from the start that the mottling and coloring is not such as to indicate that the trouble results from any type of cross fertilization. Crossing gives more general and regular results. It is also generally known that wheat is a closely self-fertilized plant. I have studied many plants and blossoms in various stages of development. These are usually found to be in such form as to indicate self fertilization. It is possible crossing may, and perhaps does sometimes, occur in the field, but very regular results ought to be expected from this natural process.

(d) Field and Garden Trials: Field and garden tests have been made to ascertain whether the white spot or "white bellied" wheat can transmit its kind. If it can be proved that it is a matter of heredity, then it is certain that this is a serious question; for even though it should be proved that no serious chemical change has occurred, such wheat, being irregular in color, will undoubtedly grade low. It would also tend to show that wheat might tend to "run out" even under best care. However, our field and garden trials do not substantiate this fear.

In a garden trial two samples of seed were tested. The two parent samples of wheat were of different origin. One grew on the college farm in 1903 and one grew at a point near Comstock, Minn., in 1903. Each sample was hand picked so as to procure seed for six drills each, (a) the white spot or "white bellied" grains, and (b) the best normal, amber colored grains. These plots were observed throughout the growth season.

Two bundles of each type of the crop were harvested, upon two different dates, August 13th and August 19th. One set of the bundles was cured under cover and one set in the field. These bundles have since been threshed. All grain which was cured in the house in the absence of moisture is perfect in color, whether its parent seed was white spot seed or amber seed. In the case of the seed cured in the field there were indications of general bleaching, but all grains were void of the typical white spots or bellies.

In more extended field work upon wheat smut a sample of seed grain was used which contained a large percentage of white bellied grains. This crop was afterwards under close study, some bundles from each of seventeen experiments being especially hand cured free from atmospheric changes. In the properly harvested and properly cured grain no white spots appeared upon the grains of the product. They did appear, however, in these same experiments where the grain was allowed to stand in the straw without being cut after the grain was fully matured.

Conclusions from the Experiments upon "White Belly" in Wheat.—We are led to conclude from the facts cited in the foregoing outline of tests that the white spots or "white bellies" are not matters of heredity. They are not due to crossing. The evidence all points to the conclusion that this peculiar mottling is due to the action of moisture, air and sun upon the grain while it is yet in the chaff. It has been observed that small grains which are well covered by the chaff scales (glumes) are not spotted in this manner, while those which are large and plump and thus protrude from the chaff scales while maturing are bleached or mottled at the points where the grains are exposed. If the weathering action has been long continued, the grains may become evenly bleached over their entire surface. Usually only the exposed sides or bellies are thus affected.

Just at this point it may be well to call attention to the fact that the color and hardness of the wheat can only be maintained by proper care in harvesting and proper curing. Good, bright, hard, amber colored grain can always be produced by the farmers of this state if proper care is taken to save it from the action of the weather when it is mature. A slight amount of moisture is sure to knock down the hardness and color grades of the grain. It is also very injurious to allow the grain to remain standing in the straw after once fully matured. Cut it and thresh it as soon as possible.

Work with Wheat Smut, Dry Process.—Each year we keep running some studies upon wheat smut. This year many attempts were made in the laboratory to develop a simple dry treatment. Farmers have continually advocated the use of some dry substance such as lime, thinking it would be easy of application to the seed and less liable to injure the seed grain.

Though we have often proved in previous bulletins and reports that, if properly handled, certain liquid treatments, especially formaldehyde, are very beneficial to seed germination, I have thought it wise to try to devise some dry method of seed treatment. This was also thought of importance, as there has of late been placed upon the market a powder which was advertised much above its merits. The dry treatment theory is not new to this department as we have previously made many unsuccessful experiments in that line. We have also elsewhere (see previous annual reports upon the use of formaldehyde gas in trials of seed disinfection) proved that moisture

must be present in order to have a rapid destruction of smut spores. One can, therefore, not expect a dry treatment to act successfully unless the treatment shall be a mild one and extended over a considerable period of time. With these points in mind, numerous laboratory trials were made in a small but exact way. In our own trials at constructing disinfecting powders and bricks to be applied to the wheat while in the bin we confined our attempt chiefly to such substances as would cause the disinfecting agent to be generated, or to become active slowly, and made an especial attempt to control the action of formaldehyde in this manner. While our trials give promise that further careful work might evolve a satisfactory treatment along this line, as in previous work with dry formaldehyde gas, we found that the disinfection was apt to be irregular in action and irregularly destructive to the seed grain and hard to control. Bricks made by mixing plaster of paris and certain solutions of formaldehyde gave most promising results, but further experiments are needed before any recommendations can be made along this line.

Ozonet Powder as Smut Destroyer.—For a time, during 1903 and in the early season of 1904, a "disinfecting" powder called "Ozonet powder" was generally advertised as a remedy for prevention of smut in all kinds of grain. We received many requests from farmers for an opinion in the matter. Numerous laboratory tests and trials were made. We found that the claims in the advertisements would not hold so far as smut in wheat was concerned, and informed the Ozonet company to this effect. The president of the company kindly consented to withdraw the advertisements concerning this feature. It will be observed that the field trials confirm the results as obtained in the laboratory.

Field Trials at Smut Prevention in 1904.—A number of field trials at preventing smut in wheat were conducted in the comparative manner employed in previous years. Each experiment was given as nearly as possible like conditions of growth. The seed used was thoroughly smutted. Notes were taken every few days throughout the growth season. At harvest time a definite portion of each plot, four drill rows of one rod each, were harvested and cured under shelter. Records have been taken upon the following points:

Total number of stools which developed.
Total number of stools which developed smut.
Total number of smutted heads.
Total number of unsmutted heads.
Total number of unsmutted heads in smutted stools.
Total weight of dry straw and grain.
Total weight of dry, cleaned grain.

The figures obtained give much information, but are rather too extended for publication at this time. The following numbers will serve as examples to illustrate the nature of the data and to indicate the general results:

FIG. 1. From a photograph of young wheat plants showing normal healthy growths, and also the stunting effect of stinking smut upon attacked plants. The two clumps of plants grew from the same seed, sowed the same day on the same soil.

Smut Experiment No. 3.—Treatment, one pound of formaldehyde to forty-five gallons of water.

The number of stools affected by stinking smut	0
The number of stools affected by loose smut	3
Total heads affected by loose smut	4
The number of heads unsmutted in the smutted stools	7
The total number of stools	352
The total number of unsmutted heads	1,113
The total weight of straw and grain from four drill rows, one rod long	4 lbs. 7¾ oz.
Total dry cleaned grain	223 grams

Smut Experiment No. 4.—Seed grain untreated.

Total number of stools affected by stinking smut	354
Total number of stools affected by loose smut	5
Total number of heads affected by stinking smut	493
Total number of heads affected by loose smut	6
Number of heads in the smutted stools, unsmutted	209
Total unsmutted heads	675
Total heads in the crop	1,174
Total stools in the crop	420
Total weight of straw and grains from four drill rows one rod long	3 lbs. 15½ ozs.
Total weight of dry clean grain	145 grams

Smut Experiment No. 5.— Ozonet treatment, two pounds of the powder to 100 bushels of grain, tightly sacked one week.

Total stools	387
Number of stools affected by stinking smut	122
Number of heads affected by stinking smut	326
Number of heads unsmutted	983
Total weight of straw and grain from four drill rows, one rod long	4 lbs. 6½ ozs.
Total weight of cleaned, dry grain	205 grams.

It will be observed that the yield of dry grain from the formaldehyde treatment, compared with that from "no treatment" in experiment No. 4, was 223 grams as against 145 grams, an increased yield in favor of the treatment of over 53 per cent, and smut was eliminated in the product.

Experiment No. 5 was conducted to conform to the recommendations of the Ozonet company. The results confirm our objections to the substance as a prevention of smut. Over one-third of the stools and heads actually produced smut and the yield was materially reduced. Other experiments, increasing the strength of the Ozonet treatment failed to prevent the occurrence of smut but greatly injured the seed germination.

A number of other experiments, based upon previous work in the laboratory were carried out on this same field plan. The following is an outline of a part of them:

Experiment No. 6.—Treatment, Ozonet, three pounds to fifty bushels of wheat exposed one week. Result, germination power much injured; 17 per cent of the grains failed to come. The crop produced 26 per cent of smutted stools.

Experiment No. 7.—Treatment, dry, powdered formaldehyde one pound, chloride of lime two pounds, mixed to 100 bushels of wheat. Exposed in sack one week. Result, present in crop, 7 per cent of smutted stools. Powers of seed germination weakened, but yield not reduced.

Experiment No. 8.—Treatment, dry, powdered formaldehyde two pounds, chloride of lime, four pounds, mixed to 100 bushels of wheat. Exposed in closed sack one week. Result, seed germination greatly injured. The amount of smut in the crops was reduced to less than 1 per cent of affected stools.

Experiment No. 10.—Treatment, flowers of sulphur three ounces, plus one-fortieth pound of liquid formaldehyde to one bushel of wheat sacked one week. Result, first growth from the seed much injured. Smut reduced to a minimum. The action was irregular. Cannot be recommended.

Experiment No. 12.—Treatment, hard coal ashes one-fourth pound plus one-fortieth pound of liquid formaldehyde, to one bushel of wheat, sacked tight for one week. Result, 5 per cent of smutted stocks appeared in the crop. The seed was also weakened in its first growth.

Experiment No. 17.—Treatment, the grain was extensively washed in running water so as to remove all smut balls, but of course this did not remove all spores. The grain was then partially dried and sacked while damp. It was then kept one week before seeding. It was thought that perhaps the smut spores thus handled would germinate then die before the grain was seeded. Result, there was a fine stand of grain from this seed, but 10 per cent of smutted stools appeared in the crop.

NOTE: It is possible that extended research might result in obtaining a dry treatment of seed grain for smut prevention, but it seems hardly probable that the requirements for accomplishing the work in farm practice can be less exacting than in the case of the present well known formaldehyde method.

The Effect of Evaporation Upon Solutions of Formaldehyde.—Farmers have often asked the question: "Must the solution which is made up for treating seed grain all be used up the same day?" "Must a new lot of solution be made up each day?" "Does the standard formaldehyde lose strength if left uncorked?" etc.

We have thought it worth while to make some special tests of this matter of evaporation, and the results are a surprise.

(1) We have boiled formaldehyde of many strengths and tested both that which evaporated and that which remained in the still; and we have made similar tests after slow evaporation at ordinary

room temperature. The results are always the same. Solutions of formaldehyde grow stronger by evaporation; that is, water is given off faster than formaldehyde.

This is an important fact. The farmer can therefore rely on a solution which have stood open for a number of days, being fully as strong as when first made.

It also gives us a pointer in regard to weakening or adulteration. Solutions of standard formaldehyde do not grow weaker from long standing unless water is allowed to get into the bottle or carboy. This also settles the complaint of the druggists that "farmers who fail with the smut treatment do so because they carelessly allow the formaldehyde to lose its strength by evaporation." And finally, it shows that the manufacturers of formaldehyde who contend that it is difficult to make water hold 40 per cent have not, perhaps, tried as hard as they might.

These conclusions were published as press bulletin No. 15, March 1904, and were based upon a number of carefully planned tests upon distilation and evaporation trials upon solutions of known strength. A part of these experiments are here tested with an indication of the methods of work and results.

1. A still was so constructed that a solution of formaldehyde could be distilled and the fluid regained without essential loss., This apparatus was used in the different distillation trials.

2. Three samples of formaldehyde which had been kept for two years in the laboratory in ordinary cork stoppered bottles, and opened from time to time for daily use, when tested chemically showed a strength equal to the normal.

3. Used 200 c. c. of a formaldehyde which tested 38.25 per cent distilled over one-half of the volume. A test of the strength of that which remained showed 47.812 per cent. After approximately three-quarters of the solution had gone over, the strength of the solution in the still showed 61.312 per cent. A test of the first ten c. c. which went over showed 22.5 per cent. A test of the sixth ten c. c. which went over showed a strength of 25.59 per cent. A test of the fifteenth ten c. c. which went over showed a strength of 37.12 per cent. Each separate ten c. c. of the distillate from the first was analyzed showing a gradual gradation of strength increasing in strength from the start. When approximately three-fourths of the solution had been distilled the distillate approximated the original strength of the solution.

4. Made up a one-half strength solution from the 38.25 solution. The half strength solution tested 19.123. Distilled over approximately one-half of the solution. The residue showed a strength of 20.25 per cent. When 120 c. c. of the 200 c. c. had gone over the remainder showed a strength of 20.81 per cent.

5. Made up a solution of formaldehyde which when tested showed .95 per cent. Placed 200 c. c. in the still. When approximately

one-fourth had gone over the strength of the solution in the still showed a strength of 1.012 per cent. Each ten c. c. of the distillate was tested and showed a gradually increasing strength. Thus the first ten c c. showed a strength of 89 per cent, while the twelfth ten c. c. showed .95 per cent the original strength of the solution.

6. Made up formaldehyde solution of different strengths and placed in open mouthed jars at room temperature for slow evaporation.

		PER CENT.
(a)	Original strength	36.78
	After evaporating one day	37.8
	After evaporating six days	42.3
	After evaporating fifteen days	Solidified.
(b)	Original strength of solution	18.56
	After evaporating one day	18.9
	After evaporating two days	19.12
	After evaporating six days	22.05
	After evaporating fifteen days	38.92
(c)	Original strength of solution	4.33
	After evaporating one day	4.38
	After evaporating two days	4.61
	After evaporating six days	5.62
	After evaporating fifteen days	10.12
(d)	Original solution, one part of standard formaldehyde to forty parts of water	.675
	After evaporating one day	.787
	After evaporating two days	.9

From these and numerous similar experiments the following points seem to be clear:

(a) Formaldehyde solutions do not evaporate or distill over in full strength. At first the distillate is much weaker than the original.

(b) The strength evaporated or distilled over gradually increases as the solution in the still condenses.

(c) When approximately three-fourths of the original amount has been distilled, the distillate approximates the strength of the original solution.

(d) In case of simple evaporation at air temperature it is definitely proven that formaldehyde solutions, of whatever strength, gradually become stronger; and,

(e) Aside from laying bare the arguments of those who would be pleased to have some apparent excuse for the fraudulent occurence of water in formaldehyde, this experiment informs the farmer that solutions of formaldehyde may be kept without loss of strength until used up. They may grow stronger, never weaker.

The Effect of Different Types of Water upon the Formaldehyde Treatment.—It was thought that, perhaps, certain types of water, alka-

line or otherwise, might act chemically upon the weak solution used in treating seed grain in such manner as to reduce its effective power. This was tested in the following manner: A like volume, five c. c. of a 38.05 per cent formaldehyde was added to 200 c. c. each of the following types of water: (a) Distilled water, (b) artesian, (c) surface well (Hammes') and (d) hydrant, Red river.

Results: There was recovered from these by analyses formaldehyde to show strengths as follows:

	PER CENT.
From the solution in distilled water	.5650
From the solution in artesian water	.565
From the solution in surface well water	.5486
From the solution in Red river hydrant water	.5489

This shows no loss to the formaldehyde when mixed with the artesian water. Though this water is heavily loaded with various minerals, these seem to have no affinity for the formaldehyde.

The water from the surface well and that from the Red river hydrant are seen to slightly affect the strength. This we are inclined to attribute to the high amount of organic matter in these two waters. However, it is safe to infer that clear drinking water will not possess sufficient of such matter to materially interfere with the effectiveness of the treatment as ordinarily conducted. The work does, however, indicate the caution that it will be wise for farmers to use as good a quality of water for this work as is available, especially avoiding waters of high organic content, such as slough water, etc. The solution as usually recommended contains but 0.1 to .12 per cent of formaldehyde. This might be materially lessened if the organic content of the water used to make up the solution should chance to be quite high.

The Influence of Age Upon the Germination of Smut Spores.— Farmers have had an idea that smutty wheat might be safe for use as seed grain if the grain should be stored for a period of years. We have made some tests of this question in previous years, but are able to add other data from this season's work. We have kept stored in the botanical laboratory a sample of Scotch fife wheat of the crop of 1898. This seed was heavily smutted. In 1899 it produced as high as 67 per cent of smutted stools. In the crop 1900, by using this smut freely upon another sample of seed, it produced a maximum of 21 per cent of smutted stools.

In 1904, the seed grown in 1898 was again used and produced 15 per cent of smutted stools. When it is remembered that very many more stools of wheat are affected by smut than showed in the heads it will be seen that aged or old seed grain is not thereby made smut free. The spores of the smut do not lose their vitality by ordinary keeping. These in this experiment were seven years old and the wheat had been kept in a dry steam heated building.

Breeding for Indemnity or Resistance to Smut.—Learning from our successful efforts in breeding flax for resistance to the wilt disease and from our long continued observations upon our yearly smut plot, we have at last come to the conclusion that our ordinary wheats may be improved in their powers of resistance to smut. Indeed the evidence is such as to indicate that they may be made wholly free from such attack. The evidence does not definitely prove that the smut fungi exert an immunizing influence upon their hosts, but is of such a nature as to indicate the importance of pushing the present experiments forward for the reason that economic results seem certain. For a number of years I have been in the habit of thoroughly smutting the seed grain used in our smut experiments and have accidentally retained the seed each year. This season, thinking to aid nature as much as possible in eliminating the smut receptive plants, this seed was again used and thoroughly smutted. This grain showed powers of developing plump, perfect seed in spite of the smut, and the great rust attack to such marked extent that its quality was noticed by many people who inspected the trials. It was found that strains of grain which least resisted smut died most easily by rust action, the two diseases acting together being sufficient to nearly destroy all plants upon some plots.

Wheat Rust.—The studies upon wheat rust have been carried along two lines: (1) Observations were made upon the conditions affecting the development of this and allied rusts. (2) And studies aimed toward gaining more definite morphological, histological and physiological knowledge of the parasite and of its chief host, the wheat plant, have been planned with a view to gaining such knowledge as will aid in devising proper steps in the breeding processes to gain resistance to the disease.

The extensive and destructive rust attack of this season has afforded especially fine opportunities for the conduct of these studies. During the maturing season I have visited many parts of the state inspecting carefully numerous and varied areas, infected and uninfected, and, aside from the general features which control rust infection and crop destruction, I feel safe in stating the following conditions under which rust becomes active and finally may become destructive:,

(1) Rust strikes early and excessively upon highly manured spots; barnyard manures and animal droppings in excess on any land throughout the state. (2) In poorly drained spots of heavy, clayey lands of the valley. (3) On gumbo and alkaline spots not sufficiently loosened or pulverized, found in many of the lighter land areas of the state outside the valley. (4) On light sandy lands, which are too deficient in fertility to complete the maturity of a heavy crop of straw and heads developed in early season. Many people are trying to raise wheat upon a soil which is too light to complete development of the spring growth. When a rust year comes

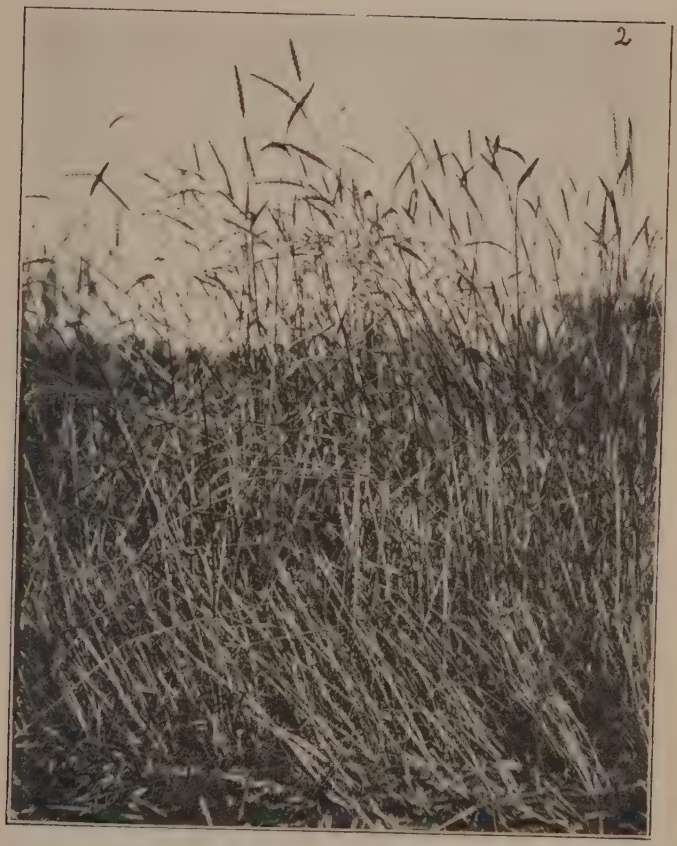


FIG. 2. From a photograph showing the effect of a rust attack upon a nonresisting strain of wheat (Shepperd's A. 68.) Photographed by Bolley August 17, 1904.

on, this crop is sure to be destroyed. The soil is unable to push it to maturity against the rust attack. (5) On good, loamy soils in various parts of the state, in which too much stubble, weeds and rubbish have been turned under. This unrotted stuff breaks the continuity of the soil, cutting off the regular supply of moisture from below the furrow slice. (6) On fields of very good texture and fine fertillty, which have been overworked, either as a cultivated crop or too thoroughly summer fallowed, thus putting the soluble plant foods in too available condition, giving an excess similar to that furnished by too heavy manuring with barnyard manure. For example, an excess of nitrogen makes soft, weak, succulent straw and retards the power of maturing seed, but furthers the growth of rust. (7) On any type of soil if not properly compacted, that is, where left exposed to atmosphere, there being no proper soil continuity from below upward, etc.

Considering these points, it is evident that careful plans with regard to proper wheat culture should avail much in avoiding excessive destruction by rust.

What to Do.—Drain your fields so that all surplus water will quickly run into main ditches. Get together with your neighbors and open all main ditches which are now blocked, and open more new ones if necessary to insure the general drainage of the whole drainage district. My observations are such as to teach that in large districts, in which the soil is of real good wheat quality and has never suffered from poor drainage, rust seldom is able to do material damage to a crop which is otherwise properly seeded. I have, however, many times observed that a slight fermentation of the soil water, due to stagnant surface water, has ruined many a fine crop upon very fertile soil, and that rust under such conditions always becomes very destructive. (2) Get all the ground ready for seeding in the fall if possible. We have observed, other things being equal, that the first wheat seeded in the spring gives the best yield and best grade and usually is out of the way of the attack of rust. It would be best for all concerned if it were possible for the people of one community to sow all their wheat within the space of a week or ten days. The late fields are always liable to rust destruction because of the first slight infection spreading from the early fields. (3) Make a good, even seed bed with good soil continuity from below upwards, and bury the seed at an even or regular depth so as to insure even development of the crop. (4) Sow clean seed of the best germinating strength possible. Such seeds tend to advance the crop rapidly, hastening the date of the harvest, ripening it to such strength that the rust cannot reduce it. (5) Sow only seed of a pure variety blue stem, Scotch fife or a pure variety of macaroni. A pure variety ripens evenly and gives an even grade. The soft bearded varieties of wheat scattered in a crop rust early and produce great quantities of spores to infect the surrounding wheat.

These scattering plants of soft wheat always furnish grain which will reduce the grade of the crop. (6) Treat all seed for the prevention of smut. Smut weakens the growth of the entire crop and retards the development of the straw. On a smutty crop the rust action is always intense, insuring its destruction. (7) Have the crop as free of weeds as possible. Weeds weaken the straw, retard maturity and tend to keep the leaves and straw of the grain fogged with moisture, especially during the cool, dewy nights. They also prevent the grain from drying off after the slight showers, which are the most effective in causing rust infection; and, when the grain needs the moisture to push it to maturity, the weeds rob the soil of that which is needed to fill the grain. Such wilting grain is sure to suffer greatly from rust infection.

When to Cut Rusty Wheat.—We have been asked many questions concerning the proper procedure in harvesting badly rusted wheat. "Should rusted wheat be cut green rather than wait for it to ripen or mature, to avoid shrinking?" There have been no reliable experiments published upon this point. We have thus been unable to answer this question definitely, though it has seemed to us that to cut the wheat too green was to place two factors against its chances of filling. It is a broad, important question, and careful tests have been made this season. There was much controversy upon the point at harvest time, and it is now evident that many farmers injured their crop by cutting it much too early. Many crops were cut green which did not possess a sufficient rust attack to materially shrivel the grain. Others greatly injured the grade and quality of their grain by allowing it to stand and bleach and weather on the straw. The following is an outline of two experiments in cutting: Two good sized bundles were cut with a sickle, tied and shocked in field as is usually done to cure. The conditions would in every sense be similar to ordinary field work as illustrated in shocks made of bundles placed together by twos

Experiment No. 1.—Crop, Scotch fife, seed treated to prevent the growth of smut:

First cutting, August 13th. Grain mostly in early dough; milk would run freely from center of the broken grains. Rust attack very heavy, black rust showing after heavy growth of red rust. The weight of 1,000 average cured grains from this crop was 10.950 grams. No full sized grains; color red.

Second cutting, August 18th. Black rust showing generally, heads yet green. Grain in dough, showing milk in center of most grains. When examined, the average grains at this early date appeared to be shrinking. They showed shrunken sides. The weight of 1,000 average grains from this cutting gave 12.080 grams. Color reddish, no full sized grains.

Third cutting, August 26th. The worst rusted straws beginning to crinkle over. Straws mostly yellow at base to a height of twelve

or more inches from ground. Grains in best, least rusted heads could be rubbed out. Weight of 1,000 average cured grains from this cutting, 14.335 grams. Color good, some full sized grains.

Fourth cutting, August 28th. Crop cut by machine. Average best straws and heads seem to be of mature color, ripe up from ground ten inches to 14 inches, heads fairly well colored in best straws. Some most rusty plants falling. Weight of 1,000 grains from this cutting, 14.789 grams. Color of the grain from this cutting normal for good wheat, some grains, approximately 10 per cent, of about full form and size.

Experiment No. 4.—Crop late sown. Scotch fife. Smutty seed sown. Crop very badly attacked by rust and smut. This grain was of the type of crop which appeared as though it would never ripen. Indeed, the upper parts of the straws and heads remained green in color much longer than wheat ordinarily does.

First cutting, August 19th. Straw quite green in color. Grain in milk to dough stage; milk ran freely. Weight of 1,000 grains, dry cured, from this cutting, 8.327 grams. Color of grain, red, badly shrivelled. No grains appeared to be over one-third weight. Poor stuff, just bran.

Second cutting, August 27th. Straw appeared to be green. The grain might be said to be in early dough; milk yet ran. Black rust showing in heavy lines. Shrunken areas showing on the sides of some of the grains. The weight of 1,000 average grains, cured and dry, 10.998 grams. Color red, average grains certainly less than one-half size and form. No full formed ones.

Third cutting, September 3. The straws were yellow three to four inches above ground. The heads and necks green and not much affected by rust. Grain in tough dough, some milk in greenest. Weight of 1,000 average grains, well cured and dry, 12.163 grams. Color good. The average grains, perhaps, somewhat more than one-half normal size and form. Some nearly full size grains.

Fourth cutting, September 5th. Black rust very prominent. Rust heavy on the neck of the straws. Average straws ripe eight to ten inches at base. The kernels show a tendency to form the mature color, green yet prominent. Many grains show shrunken sides. Weight of 1,000 average cured grains of this cutting, 12.743 grams. Color of the seed good. Size of grains average one-half to two-thirds normal form and size. Many grains three-quarter size and form or better.

Fifth cutting, September 6th. Straws mostly yellow twelve to fourteen inches above ground, necks of straw yet green, rust very heavy, straw crinkling. Some grains of good color. Some heads of mature color. Weight of 1,000 average grains from this cutting, 13.503 grams. Some grains nearly full form and size. Average grains appear to be about one-half to three-quarter size.

Sixth cutting, September 7th. Best straws the ones least attacked by rust, mature in color to the necks. Best heads mature in color. Some heads could be rubbed out easily. Grain generally seem to be badly shrivelled. The weight of 1,000 average grains from this cutting 13.072 grams. Color fair, slightly bleached. Some grains, say 10 per cent, more than three-quarter normal size and form.

Seventh cutting, September 15th. Crop cut by machine. At least 10 per cent of the straw broken over because of severity of the rust attack. Best plants over mature. The weight of 1,000 average grains from this cutting 13.573 grams. Color of grain not so good as in other samples, weathered some.

From these experiments and our observations, I am led to conclude that, no matter how severe the rust attack is, one is not justified in cutting the grain before the ordinary signs of maturity. Even in the most destructive attacks of rust there may be expected a certain per cent of plants which are not sufficiently injured to prevent them from fully ripening the grain. These plants are the ones which cause the increase by standing. Plants which rust so badly as to fall over have upon examination been found to contain shrunken grain of very little value. One can afford to lose a small per cent in this way rather than to cause all of the grain to be shrunken from immaturity by cutting too soon. By an examination of the figures given, it will be seen that the yield of grain increased in weight up to the point at which it was thoroughly mature. In deciding when to cut, one must judge each field on its own merits. The average grain should show no trace of green or milk when broken. The climate in the state generally at harvest time is such as to cause all cut grain to shrivel at once of cut too far on the "green side." Of course, after the average plants of the crop are mature, there will be a loss in the grade, color, hardness, etc., for every day which it weathers in the straw. To be explicit, it may be said that one cannot expect wheat to do much ripening in the straw after it is cut.

How to Breed for Resistance to Rust.—In a number of addresses given during the year, before various associations of plant and animal breeders, I have formulated and advocated the use of a new process to be applied in breeding, looking toward a direct application of the survival of the fittest principle as an aid to breeding. I have labeled it "The Promotion of Disease to Eliminate the Weak and Undesirable Strains in Farm Crops."

Darwin put forth the idea that plants and animals vary in nature, that no individual is ever quite like its parent, and that it may have characters wholly different from either of its parents, that is, new characters. He founded his great idea of the origin of species upon

*See Proceedings of the Tri-State Grain Growers Convention, Fargo, January 17, 1905, and Proceedings of American Breeders Association, Champaign meeting February 2, 1905. See also Press Bulletin No. 22 North Dakota Experiment Station.

FIG. 3. From a photograph of a resistant plot of high-bred wheat (Shepperd's A. 55), seeded under the same conditions as the wheat shown in Fig. 2. Tagging rust resistant plants. Photographed by Bolley August 17, 1904.

these propositions, explaining that those plants and animals are on the earth today which happen to possess qualities of body and habits of life which fit them to resist the harsh conditions of nature with which they come in contact. This is the doctrine of the survival of the fittest. It can be made to mean the survival of the useful.

Experiments at this station prove that the survival principle works well in breeding farm crops, and show that it will be easy for our farmers to help the process along in growing wheat and other crops. I have found that it has special bearing upon the methods which should be pursued to escape the action of diseases which attack farm crops. It is found that one can breed plants which take disease easily and types which resist disease, indeed ones which are quite free from the attack of such diseases as wilt in flax and rust.

We have obtained those first resistant plants in a short time by promoting the greatest possible development of the particular diseases which we wish to study. We place the plants we wish to test under all of the disease conditions of the soil, air and water that we can help nature produce, then save the seeds from those plants for future trial under similar conditions year afer year. This is a new method in experimental work, and has given astonishing results with the flax plants both with reference to rust and wilt. Though the experiments have not run as long a time, we have even more promising results with potato blight, wheat rust and wheat smut. We now know that we are on the right track to procure resistant and immune varieties. The processes are simple and every farmer can take part in the work.

What do these experiments and observations teach? Much which is of great worth to wheat growers: (1) That the methods of grading and selecting farm seeds heretofore recommended and in use by most able farmers are along correct lines and should be followed rigidly; because these grading processes not only tend to save the naturally big yielders but to discard the weak and nondisease resisting strains of grain. (2) It teaches that when a farmer removes a light weight, shriveled grain either by fanning or screening he removes from the seed a grain which came from a weak, sick plant or from one which could not produce a good plump grain under the conditions in which his crop grew. (3) That the farmer ought not to continuously change his type of seed grain, but should breed up a strong strain to fit his own local conditions. To do this he should grade out all of the light weight, imperfectly shaped grains and save the plump, perfect ones. These last grew on plants which could resist trouble, plants which were strong and resistant of disease and hard conditions of soil and weather.

Wheat From a Rusty Crop.—All this applies very directly to the question of using seed from the present rusty crop. Because of the reasons just given, I recommend that the farmers in the rust infected districts procure the seed from their own crop, if it is possi-

ble to screen out enough heavy grain for that purpose. If one-third of the grains are heavy weights, most farmers will be able to do this by extra work with the fanning mill. Remember that a rust year is a good year in which to sort out a vigorous strain of seed wheat; for the rust shrivels the grains of all of the plants which cannot resist rust and hard weather and soil conditions. Clean out the light stuff. Save the plump.

A Good Year to Purify the Durum Wheats.—I also call attention to the fact that there are several varieties of durum wheat being grown in this state, and that while most durum wheats are more resistant to rust than the ordinary wheats, some of them rust very badly and are of less value than others. A year of heavy rusting gives an ideal chance to purify the durum seed. Good rust resistant durum is plump as in ordinary years. Where it is mixed with poorer types of durum and has an admixture of the ordinary or soft wheats, the soft wheats and weak durums are badly shriveled and therefore can be easily removed by use of the fanning mill or seed grader. Don't forget it. It will pay you to purify the durum.

If the screens in the fanning mill are not suited for the work, have some made that are right. Buy the mesh or perforated metal and make them. It is easy.

We have made numerous germinaton and growth tests upon light weight wheat from rusted, frosted and other types of immature, shrunken wheat. From these studies we learn that we ought not recommend the use of any type of light weight grain for seed.

Germination of Light Weight Wheat From a Rusted Crop.—Bright colored, otherwise uninjured, light weight wheat from a rusted crop germinates freely under good soil conditions; and, if the average weight of the grains of a sample are above one-half the normal weight of sound wheat, will probably produce a stand when the usual amount of seed is used per acre. Such seeds produce thin-stalked, narrow-leaved plants with weak vitality and slight powers of stooling. The large number of grains per bushel may in part make up for the loss in living and stooling powers. Plants from light weight grains are always liable to die if the soil happens to be either poorly drained, heavy and cold, or very drouthy just following the germination date.

Some Rusted Wheat Which Should Not Be Used for Seed.—There are, perhaps, few farmers, even in the heaviest rust districts, who have failed to raise enough heavy weight wheat for seed purposes. If there are no full weight grains in the crop, I cannot recommend its general use for seed, because it shows that there was no rust resistant wheat in that field and because it will be hard to screen out enough heavy grains to insure a stand of strong plants. If light weight rusted wheat has been subjected to much wet, has been heated or weathered, it ought not to be used for seed. Shriveled rusty wheat never properly matured. It easily becomes soft and, in the

FIG. 4. From a photograph, showing the different grades of wheat grown in one of our specially prepared rust infected wheat plots. Breeding for rust resistance. Farmers should grade their wheat so that only the plump sort of grains remain. Graded from 1904 crop, plot No. 2½.

presence of moisture, loses its growth power much sooner than plump, hard wheat. Every farmer who doubts that his seed grain will germinate and make a good strong growth ought to try some of it in a box of earth at once, or in some simple germinator such as a deep plate or dish filled with moist sand. Try some sound, mature wheat with it as a check on the trial. As to weight, I can give no fixed rule, but recommend that grains which are to be used for seed purposes should at least be of three-fourths the normal size and weight.

Germination Tests on Canadian Frosted Wheat.—A test case being on trial before a special court to determine the status of Canadian "frosted" wheat under the Dingley tariff act, I was asked by a special agent of the United States treasury, Mr. W. S. Chance, to conduct test experiments upon the official test sample to be placed before the court.

The testimony now having been taken in the case, and the facts which I obtained in these germination tests being of general interest, they are here reproduced in tabulated form. The tables show who counted out or selected each sample hundred of seed, the kind of test which was made, that is, what sort of germinator or test was used and the strength of growth which was shown in each case. A check sample of very high grade, evenly graded wheat was used with each trial.

The sample is known in my record books as 189. The various separate tests are conducted under the numbers a-1 to a-4 and b-1 to b-4.

Results of Tests.—The seeds tested were representative of the sample, 100 straight, average grains:

Selector	Test	Strength			
		Strong	Medium	Weak	Total
Bolley	Greenhouse, soil	31	20	7	58
Bolley	Sand filter	42	12	24	78
Pritchard	Copper pans	40	13	12	65
Pritchard	Geneva pans	54	12	17	83
	Approximate av.	41	15	15	71

Test No. 2.—This test represented the growth from 100 best grains taken from 200 average grains of the sample:

Selector	Test	Strength			
		Strong	Medium	Weak	Total
Bolley.....	Greenhouse, soil..	52	11	13	76
L. R. Waldron....	Sand filter.....	51*	12	16	79
Pritchard.....	Copper pans.....	30	24	23	77
Pritchard.....	Geneva pans.....	62	9	16	87
	Approximate av.	49	14	17	80

* Hurt by drying.

Test No. 3.—Test of 100 poorest seeds taken from 200 average seeds:

Selector	Test	Strength			
		Strong	Medium	Weak	Total
Bolley.....	Greenhouse, soil..	23	18	17	58
Bolley.....	Sand filter.....	46	6	16	68
Pritchard.....	Copper pans.....	25	19	18	62
Pritchard.....	Geneva pans. ...	45	14	19	78
	Approximate av.	45	15	17	67

Test No. 4.—Test of 100 worst weathered grains in several hundred grains:

Selector	Test	Strength			
		Strong	Medium	Weak	Total
Pritchard.....	Sand-filter.....	34	10	15	59

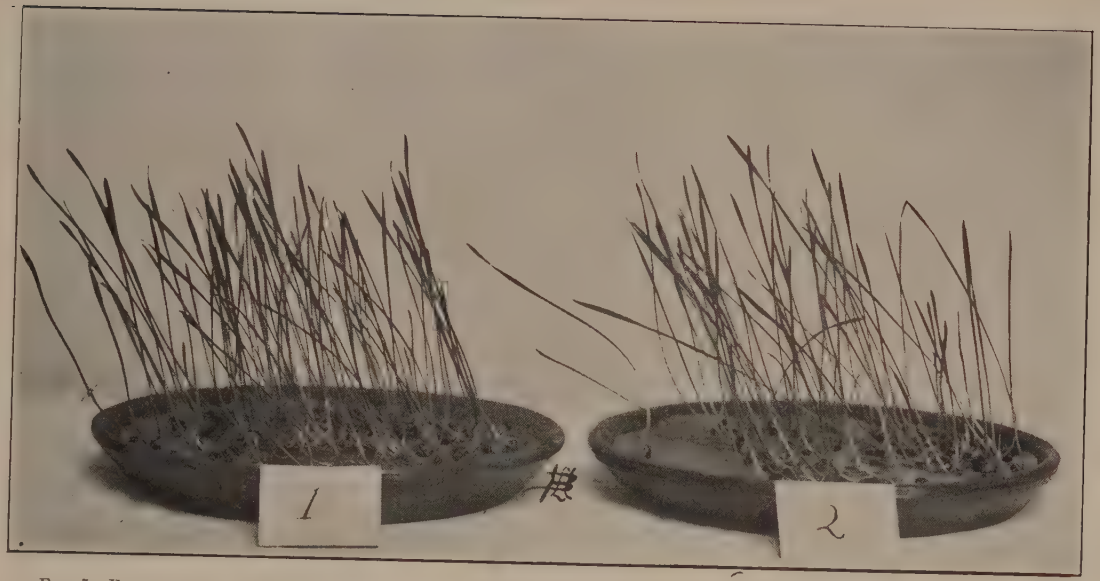


FIG. 5. From a photograph illustrating the sand and paper germination pan. The young plants are eight days old. No. 1 represents the growth from first-class wheat. No. 2 represents the growth from the Canadian test sample of "frosted" wheat.

Test No. 5.—Test of the check sample:

Selector	Test	Strength			
		Strong	Medium	Weak	Total
Bolley	Greenhouse, soil	73	19	3	95
L. R. Waldron	Sand filter	72	13	11	96
Pritchard	Copper pans	57	22	16	95
Pritchard	Geneva pans	65	12	19	96
	Approximate av.	67	16	12	95

This check sample was Scotch fife wheat grown on the station farm in 1903, quality No. 1 hard Shepperd's best pedigreed farm wheat, hand picked by T. F. Manns to an even quality and size of grains.

OTHER NOTES.

Weight of 100 average grains of the check, 3.2115 grams.

Weight of 100 best grains from 200 straight or average grains taken from sample No. 189, 2.7868 grams.

Weight of 100 poorest grains from 200 straight or average grains taken from sample No. 189, 2.0245 grams.

It will be noted that the average weight of the grains from the check sample is considerably greater than that of the best grains of the sample under trial. This would in part account for the stronger first growth shown in the seed tests.

Date of planting in greenhouse October 8th.

The height of the best plant in check December 13th, 24 inches.

The height of the best plant in sample 189, twenty-two inches.

The height of the best plant from the 100 poorest seeds from sample No. 189, twenty-two inches.

The weight of four best greenhouse plants from check samples December 13th, fifteen grams.

The weight of four best greenhouse plants from the 100 best seeds from sample 189, sixteen and one-half grams.

The weight of four best greenhouse plants from the 100 poorest seeds of sample No. 189, thirteen and one-half grams.

These figures show well the comparative merits of heavy and light weight grain. Sample No. 189, the Canadian sample, was heavily frosted but thoroughly well cured. It contained a high percentage of shriveled grains due to immaturity; only about one-half of the grains were of full weight. The germination tests, however, showed quite clearly that the contentions of the importers that such wheat "would not germinate" was not well founded. The comparative strength of the growth from the check sample and from the Cana-

dian "frosted" sample is well shown in the accompanying cut from a photograph of one of the trials.

The Effect of Frost Upon the Content of the Wheat Grain.—It was also contended by the importers of sample No. 189, the "official sample" of Canadian frosted wheat, that the frosting rendered it unfit for millng purposes and hence that it was unfit for human food as flour. I made some study of this question to satisfy my own curiosity.

By carefully softening and sectioning the grains, I was enabled to make careful microscopical tests of the contents. I found that the characteristic wrinkling of the surface of the grains was due to the effect of the frost upon the pericarp (outer bran layer), but that there was no apparent change or effect upon any of the inner layers or contents of the grains. I had to conclude that if such wheat was thoroughly scoured it would make flour in the same sense as any immature wheat of a like stage of development at harvest time.

Such a question, however, cannot be well settled by such studies upon indvidual grains. It is worthy of the careful attention of the chemist, as it is only upon an accurate knowledge upon such features that an intelligent national grain inspection can be founded. I have seen all grades and types of wheat, hard and soft, immature and frosted, included as a mixture going to the "first break" in one of our great mills and the "best" grade of flour being sacked for market. Undoubtedly low grade wheats are used for making high grades of flour. It is but another argument that systematic methods should be established by the general government so that each type of wheat offered on the market may have an accurate rating. A systematic regularly accurate system of grain grading would do more to induce our farmers to produce high grade, well bred wheats than any other possible innovation.

EXPERIMENTS UPON POTATOES.

Review of Work in Previous Years.—During the years 1888 to 1900 I was engaged in a study of the disease known as potato scab (*Oospora scabics*) and conducted many experiments to learn how to treat the disease for preventon.* Throughout this time the methods of cultivation were very carefully done, and each hill was closely observed as to all features and the causes accounting for them. Other potato diseases, such as blight and rot, often interfered. While these may be introduced by the seed piece and remain from year to year in the soil, they also spread from plant to plant and from field to field in an infectious manner. During those studies, I often noticed what appeared to indicate a tendency to immunity on the part of certain individulas or strains. To be specific it was recorded

*See North Dakota Experiment Station Bulletins Nos. 4, 9, 19 and 37.

FIG. 6. From a photograph of a blighted and rot infected potato plant. A rather typical specimen, to be seen in the heavier soil regions of the state.

that some strains rotted, scabbed or blighted more easily than others and that certain hills or strains seemed to be quite clearly resistant.

During the seasons 1893 to 1900, close work was done upon a type of pedigreed, selective work. The seed tubers were always selected at digging time from hills of known performance. The work started with a known variety, the Early Ohio, and the pedigreed record of each was carefully maintained. Each year two hills were grown under as nearly equal conditions as possible, using for seed a two-ounce piece from a large and a small tuber. The results of the experiments to date of 1897, so far as the central idea for which they were conducted was concerned, were in part published in bulletin No. 30. The results of the years 1898-1900 are compiled in unpublished tables and notes. A study of these notes and tables and a consideration of numerous special observations made each year upon the growth, habits and features of the different selected strains with regard to strength, gives great light on the disease resistance feature and upon breeding propositions generally.

The experiment was started in 1895 by planting two hills as noted from each of the hills selected in the field in 1894 because of their separate variant characters. In order to prevent the experiment from becoming too extended for close observation, a part of the hills were discarded each year. Some strains were discarded because of special qualities which unfitted them for the tests. Among these were those which showed a marked tendency to rot and blight, to prevent which diseases no provisions had been made.

It is interesting to note in these tests that though the methods of culture remained the same the yield per hill became greater each year and blight and rot less and less apparent. I atribute the increase to two features: (1) Selection for growth powers; (2) elimination of the nondisease resistant plants.

Present Work on Potato Diseases.—With these facts in mind, we have been studying the development of potato diseases in certain pieces of soil and their effects upon successive crops. The observations, taken with our other studies upon immunity and resistance, lead me to the belief that even the potato is amenable to improvement along the lines of resistance to the diseases which attack it. We have therefore running some special experiments looking to the elimination of the non-disease resistant strains through the action of heavy disease producing conditions artificially produced and persistently maintained. The work gives much promise. Though the potato is bred qutie true to its types, so that a particular disease seems to attack it quite easily, yet there are always found plants of promise. Fortunately the potato reproduces with great rapidity, and it is easy to make and to keep breeding strains pure.

EXPERIMENTS ON INTERNAL TREE FEEDING AND MEDICATION.

In the fourteenth annual report, page 55, some experiments were outlined upon "internal feeding of trees." The object of the work is to be able to make a direct attack upon certain physiological and pathological diseases of trees. Sixteen trees have been fed during the folage season of 1904, one maple, four plum, four cotonwood and seven apple trees.

In previous years, normal trees were fed to determine the features characteristic of the absorption process, the strengths of solutions, etc. This season diseased trees were fed. The apples were affected by blight and "sun scald," the plums by "plum pocket" and the shade trees by "sour heart" or some unknown physiologcal derangement which gave a typical blighting effect. The studies need a more detailed summarization than can be given at this time. Many interesting observations have been made, and we believe that we have sufficient facts to warrant the belief that valuable individual trees may be saved from the action of certain disease by this method of work: but extended experiments may be necessary before the work may be open to use in practical horticulture. This work will later be published in bulletin form.

THE WORK OF ASSISTANT BOTANIST L. R. WALDRON.

The experimental work upon weeds and forage plants is under the care of Assistant Botanist L. R. Waldron. He has continued a number of the studies prevously outlined,and is paying especial attention to such experments as seem likely to furnish information in controlling weed pests. I append his report upon the following topics: (1) Vitality of weed seeds planted in 1899. (2) Special experiments with *Thlaspi arvense*, Frenchweed. (3) Effect of Frenchweed upon the growth of the wheat crop. (4) Relative aggressiveness of different weeds. (5) Russian grasses and forage plants. (6) Red clover and bumblebees. (7) Age of maturing in wild oats.

VITALITY OF WEED SEEDS PLANTED IN 1899 AT VARIOUS DEPTHS IN RED RIVER VALLEY SOIL.

This experiment was planned by H. L. Bolley in 1899 and was outlined and some of the results given in the tenth, eleventh and twelfth annual reports, and a general summary was given in Bulletin No. 62, Weed Studies, by L. R. Waldron. In June, 1904, a portion of each row was dug and the seeds tested. The following results were obtained.

Shepherd's Purse.—One growth each from mass of seed buried five and ten inches. Unable to distinguish seeds.

Frenchweed.—Over 200 seeds counted out and left in the Geneva germinator three weeks with no growth whatever. Some of these seeds were saved, dried, and three months later were tested again.

FIG. 7. From a photograph of a healthy potato growth, apparently resistant to the common blight diseases.

At that time the seeds germinated nearly 90 per cent. Evidently very few of the seeds had rotted or germinated in the soil, as they seemed to be as abundant as when first put in.

Green Foxtail.—Most of the seeds rotted or previously germinated. Seeds buried five inches, one germination from twelve seeds. Seeds buried ten inches gave a percentage germination of 6 2-3.

Kinghead.—In nearly all cases where seed was found, the outer envelope (*involucre*) had rotted away, and in some cases even the embryo was laid bare. This looked healthy in some cases. Most of the seed had evidently grown or decayed. Three-inch seeding, two seeds, no germination. Five-inch seeding, sixteen seeds, no germination. Seven-inch seeding, thirty-nine seeds, no germination. Ten-inch seeding, fifteen seeds, four germinations.

Wild Mustard.—Three-inch seeding, fifteen seeds, four germinations. Five-inch seeding, 100 seeds, 16 per cent germinated. Seven-inch seeding, 100 seeds, 27 per cent germinated. Ten-inch seeding, 100 seeds, 11 per cent germinated. It is quite possible that a larger percentage germination could have been secured had the seeds not germinating at that time been tried again later on. The seedlings that did start were vigorous.

Wild Buckwheat.—Seeds all decayed. The outer seed envelope (wall of the ovary) was present and not much decayed. Means of decay, such as fungi and bacteria, seem to have gained access along the angles of the seed.

Wild Oats.—Seeds all decayed, almost beyond recognition. The results of this experiment in regard to the wild oats is contrary to the received opinion. This part of the experiment is being repeated.

SPECIAL EXPERIMENTS WITH THLASPI ARVENSE (FRENCH WEED.)

The plant is locally known as Frenchweed and more generally as pennycress. While all annual weeds yield to the same general methods of cultivation, yet in the case of the most pernicious, it is often worth while to know the life history more exactly so that they may be attacked at their most vulnerable points. Some features of the life history of Frenchweed proved highly interesting, and seemed to indicate methods which might be used against it. It is an annual, but generally starts in the fall, lives over winter and ripens its pods in June. This is the winter annual form. The summer form starts in the spring and ripens its pods in July and August.

Seeds in Wintered Pods.—When Frenchweed ripens its seeds in the late fall, as it does occasionally, cold weather generally catches the plant before all of the seeds are ripe or distributed. In the spring the plant appears to have mature pods which contain seed. Germination tests were made of such seed in the spring to determine if any were viable. A total of twenty pods were examined, care being taken to select the largest and most mature looking. One hundred and sixty-three seeds were examined, seventy of which were light

colored and shrunken, thirty-four appeared of medium quality and forty-nine of fairly good quality. From this number there were but four germinations, three of which came from the light and shrunken seed and one from the medium quality. Two of the seedlings were very weak.

Germination of the Green Seed.—It is stated by farmers that Frenchweed plowed under, with developing pods, will keep on developing the seed in the pods practically the same as if the plant had been left untouched. A plant was selected July 18th that had ceased blossoming, but that had developed no ripe pods. The oldest were beginning to turn from green to yellow. This was buried in the ground at a depth of four inches. On September 19 the plant was dug up and found quite badly rotted. A large number of the seeds were germinating, including some from pods that were quite green. Other seeds, not yet started, were tested in the laboratory and germinated freely. It is quite certain that these seeds would not have grown so soon if the plant had been dried, instead of buried in the ground. Four pods were selected and labeled "green," "yellowish," "nearly ripe" and "ripe," and used as control. None of the seeds from these pods grew, though kept in the germinator for three weeks. It is apparent that Frenchweed plowed under when the pods have attained their size (not maturity) will develop viable seeds, sooner, than if the plants had remained above ground.

Pod Growth.—Studies were made upon the rapidity of growth of the Frenchweed pod and upon the time required to mature the same.

On June 30, a flower in blossom was selected. July 2, petals still on, pod measured 2x2½mm. (thickness not measured); July 4, petals off, pod measured 4x5 mm.; July 5, pod 5x6 mm.; July 6, pod 5½x7½ mm.; July 7, pod 7½x9 mm.; July 8, pod 8½x10½ mm.; July 10, pod 11x13 mm. It retained this size until ripe, August 3. Similar measurements were made upon several other pods, and the rate of growth was nearly the same during the active growing season. The pods gain about a millimeter a day in length and in breadth, until normal size is attained, and then the energy of the plant is turned to the formation of seed. It thus happens that the plant has the use of the leaf-like pod for the longest practicable time. The bed containing the plant from which the above measurements were taken was seeded May 2, and first seed ripe July 18, seventy-seven days from sowing.

Generations per Year.—Tests were made to ascertain if two crops of Frenchweed seed could be produced in one season, starting with one lot of seed or with one plant. Plants were selected early in May which had started the fall before, and transplanted to the Frenchweed bed. These grew rapidly and had ripe pods by June 15th. The seed from these plants was sown at that time, but no germination resulted until early September. These plants did not flower that season, but went into winter condition with only root leaves. From the seed

sown early in the season, ripe pods were gathered July 18. The seed from this was sown that date, but it did not germinate until early September and went into winter condition like the preceding. Only one crop of seed produced in 1904.

Time Required to Mature Seed.—In July, 1903, a quantity of Frenchweed seed was gathered from very ripe pods, the valves fell at the touch. On April 15, 1904, a germination test was made of this. But 1 per cent grew and the test of the one seed was evidently broken. Wheat under similar conditions germinated 97 per cent. A sowing of the Frencheed seed was made out doors May 5 and less than 1 per cent germinated, while wheat in the same bed germinated nearly 100 per cent. On July 13, 1904, a laboratory test was made of the same Frenchweed seed resulting in a germination of 85 per cent. The seed sown with the wheat May 5 did not germinate until the fall rains, about September 1, which allowed the plants to get into good winter condition. We may assume, I think, that the growing wheat kept the soil too dry for the germination of the Frencheed, after the seed had matured. As soon as the first heavy rain came, after the wheat had ripened, the seeds germinated. The rainfall of the growing season was about the average, being somewhat below the normal in August.

It is evident that there are at least three classes of Frenchweed seed that we have dealt with: (1) Seed gathered with grain in harvest time, stored dry and sown with the grain the following spring. (2) Seed from the winter annual plants which falls to the ground in June. (3) Seed from the spring plants which falls to the ground in July. In these three cases the seed did not germinate until September. This was in time to put the plant in good conditon to live over winter.

Conclusion.—The conclusion from this seems to be that the Frenchweed is a pernicious plant only as a winter annual. If the seed bed of the grain field is harrowed clean before seeding, or if the land is spring plowed. Frenchweed will be uncommon in the grain unless an older crop of buried seed be brought to the surface to grow. This concluson is substantiated by the few field observations made by the author. A very wet season might change the results somewhat and some exceptional seeds may germinate soon after the pod is ripe.

If the ground is filled with the weed seed ripened in previous years, and if that be brought to the surface by plowing or harrowing, the weed seed will probably germinate along with the wheat and many Frenchweed plants will be found in the wheat. Such plants are generally small in size but sometimes number over 100 to the square foot. The actual injury of these plants to the wheat crop is an unsettled question, needs further study. It is evidently great in a dry time.

Observations upon two other winter annuals, peppergrass (*Lepidium apetalum*) and tumbling mustard (*Sisymbrium altissimum*), confirm the general conclusion. Peppergrass was seeded May 2. The following is taken from my notes: May 16, "Coming nicely, seed leaves open." May 18, "Seedlings make slow progress." July 1, "Seedlings nearly dead." July 29, "Seedlings just beginning to come on." August 16, "Seedlings just living." In the same bed were three plants of the winter annual form which throve vigorously. The seed of the plants with retarded growth was of excellent quality. It is remarkable why the seeding of May 2 acted as it did. It is possible that cool (fall) weather is necessary for the early growth of the plant. If further work confirms the above it is certain that peppergrass is a pernicious weed only as a winter annual.

Tumbling mustard seeded May 3, made an excellent growth but did not blossom until late. On July 1 plants were six inches high but stemless. On July 15 two plants had sent up flowering stalks and were beginning to blossom. August 2, "Flower stalks becoming abundant. Will not produce much seed this year." No ripe seed was produced until the middle of October and it did not start seedlings that season. Some of the plants that germinated in May did not send up flowering stalks that season.

Tumbling mustard, seeded with other plants in the spring, showed itself very weak as indicated in a following experiment. It is very certain that this plant is a pernicious weed only as a winter annual, that is to say, it does most harm the second year from the seed.

EFFECT OF FRENCHWEED UPON THE GROWING WHEAT CROP.

Three plots were prepared, each of which was sown to good wheat at approximately the field rate. In addition, two of the beds received a sowing of Frenchweed so arranged that each of the two beds received approximately the same number of seeds of wheat and Frenchweed. The Frenchweed seed was of the lot gathered in the preceding July, which, as indicated before, was not yet mature. The wheat germinated and grew, but only a very few of the Frenchweed plants started at the time—not enough to affect the wheat crop. A much larger number of the Frenchweed grew in August after the fall rains. In order to make the experiment a success it would be necessary to use seed that had been collected more than one season. It would be well worth while to compare the effect upon the wheat of the Frenchweed plants starting in the spring with the effect of those starting in the fall—the winter annual form.

RELATIVE AGGRESSIVENESS OF DIFFERENT WEEDS.

Eight hundred seeds each, of six different kinds of weeds, were counted out and sowed May 10, 1904, in a bed 5x7 feet. The kinds of weeds were: Russian pigweed (*Axyris amaranthoides*), tum-

FIG. 8. From a photograph showing a portion of flax sick soil on plot 31. Photographed June 25, 1904, showing that the various samples of common flax planted on that ground utterly failed. Compare this photograph with Fig. 10.

bling mustards, wild mustard (*Brassica arvensis*), Frenchweed, false flax (*Camelina sativa*) and ball mustard (*Nesla paniculata*). The percentage germination of the above seeds was good except Frenchweed, the seed of which had not yet "matured." The seed had been gathered the previous year in excellent condition, was well dried and had been stored carefully. Seedlings began to appear May 16. On July 1 wild mustard showed most abundant leaf surface and false flax next. On July 19, when the plants had evidently attained their maximum size, they were pulled, counted and the relative sizes of the piles estimated. The number of plants of each kind were: False flax, 520; wild mustard, 356; Russian pigweed, 281; ball mustard, 195; Frenchweed, 24; tumbling mustard, 3. Estimating the wild mustard pile—the largest—as 10, false flax came next as 6, Russian pigweed 1 (plants small), Frenchweed .5, ball mustard .5 and tumbling mustard .05. This emphasizes the weakness of tumbling mustard, especially when it has to cope with really aggressive plants and it shows how little it need be feared when it is placed in competition with a rapidly growing crop, even such as wheat. When tumbling mustard injures a grain crop it is because the grain is sown in a field full of tumbling mustard plants already half grown. Russian pigweed and ball mustard also show a decided weakness when they cope with their superiors.

SPRAYING EXPERIMENTS TO KILL WEEDS.

A preparation known as Thistleine for spraying upon weeds was sent to the station to test. It is a blue deliquescent salt put up in five-pound cans which sell for $2 per can. Prof. E. F. Ladd reported the substance to be mainly aluminum arsenite. The blue color he attributed to organic impurities. He thought the substance to be a waste product obtained in the manufacture of some substance, possibly a coal tar product. There is enough of the arsenite in each can to make five gallons of solution of the strength recommended by the manufacturers.

Effect on Annuals.—It was found that the solution was much too strong to spray on weeds growing with grain, and stronger than necessary to kill annual weeds which the solution would wet.

Effect on Perennials.—Spraying experiments were tried on Canada thistle, and also on quack grass, with Thistleine, using known solutions of copper sulphate and sodium arsenite as check.

Experment No. 1.—One gallon of Thistleine solution was sprayed on twenty square feet of thistles June 25. June 27, aerial portions of thistle withered and brown. July 6, there were no thistles appearing. July 11, a few thistles beginning to start. August 2, resprayed. Many thistles started after the second spraying. An examination was made of the root stocks of the sprayed thistles and it was found that they were alive and apparantly healthy except a

small portion near the surface. This result is contrary to the claims made for the spray. It is stated in an accompanying circular that "The poison is absorbed through the leaves into the circulation of the plant and follows the sap to the tiniest root. A Canada thistle treated wth Thistleine never grows again." They account for the appearance of thistles after spraying, to the fact that the bed is thoroughly "seeded." It is seeded to be sure, but with root stocks more than with seeds. The reason that so long a time elapsed before young thistles appeared above the ground after spraying, nearly two weeks, was possibly due to the ground receiving enough of the spray to keep it poisoned for a time.

Experiment No. 2.—Sodium arsenite (c. p.) was used, one ounce to one gallon of water, double the strength used in spraying weeds in grain.* When applied to same area of thistles as above, it was almost as effective as Thistleine. July 6, thistles still dead on spraying area. July 26, many thistles up. Ground evidently not poisoned as much as with the Thistleine.

Experiment No. 3.—Copper sulphate (c. p.) was used, one pound to one gallon water, double the strength used in spraying weeds in grain. It was applied as above, June 27, apparently not quite as effective as Thistleine or sodium arsenite. July 6, some of the sprayed thistles were sending out shoots and new thistles were coming up.

Experiment No. 14.—Copper sulphate (com.) was used at rate of twelve ounces to one gallon water. Sprayed July 7. July 10, plants killed to the ground. July 25, a few plants coming up. This was about as effective as Thistleine.

Results.—1. It is evident that the Thistleine has no special value over sodium arsenite or copper sulphate. 2. The cost of Thistleine is very much more than either of the other chemicals. 3. If Canada thistles are killed by spraying it is because the foliage is kept killed and not because the poison is carried through the plant. 4. The relatively long period of time before the thistles start after spraying is perhaps due to the surface of the ground retaining some of the poison.

Quack Grass.—The sprays named above were used on quack grass but without materal effect, as the solutions did not wet the leaves. Solutions of commercal copper sulphate, one pound to two gallons water, and sodium arsenite, one ounce to one gallon water, were poured on quack grass areas and though the quack was retarded in growth, no permanent injury seemed to result. It would require generous applications of the liquid to be of marked benefit which would be apt to have an injurious effect upon later grown crops.

* See North Dakota Eleventh Annual Report, p. 53.

FIG. 9. From a photograph showing the difference in the growth exhibited by an *immune* strain of flax (a) immune 22, fourth generation, and (b) *ordinary* wilt infected flax on the same sick soil. Photographed June 25, 1904.

RUSSIAN GRASSES AND FORAGE PLANTS.

Professor Bolley introduced some plants from Russa which were tested in the grass garden. As they have been grown but for one season, very little can be said of their value. Six varieties of grasses, mostly native to Russia, were tested. No. 10226, cultivated *Bromus inermis,* did much better than any of the others.

Four sowings of alfalfa were made from as many different selections, all of which did nicely.

Three kinds of vetches were tested, one native. Only a few plants came from each kind. Some seeds of *Lathyrus sylvestris* (Wagner's forage plant) were sown with no growth. A Russian native clover was sown resulting in two plants.

A plot of *Coronilla varia* (ax seed) was sown. It made slow growth at first but later grew vigorously. A plot of *Lotus corniculatus* (birds-foot trefoil) was sown. It made a weak first growth but later did much better.

Two varieties of lentils were tested, neither of which promised much, probably due to the heavy character of the soil on which they were grown.

RED CLOVER AND BUMBLEBEES.

While the common red clover is apt to suffer in North Dakota by winter killing, yet when it blossoms it produces seed abundantly. A good bit of red clover blossoms upon the station grounds every year, and an examination of several heads showed that the number of flowers in a head which developed seed-bearing pods ranged from 54 to 92 per cent. As the bumblebee in North Dakota seems far less common than in the eastern states, it seems to be doubtful if they are abundant enough to pollinate the clover. The work accomplished was not conclusive, yet it seemed to demonstrate that the clover requires insect aid in pollination. The heads experimented on were protected by muslin bags tied over them and in no case was any seed formed. Parts of the bags were made of very coarse muslin having but eight threads to the centimeter. A wire basket having five meshes to the inch was inverted over some clover heads. Only about 3 per cent of the flowers of these heads developed seeds. These flowers might have been pollinated by the bee from the outside. A bumblebee was seen working on the clover heads in the plot on two different occasions while the experiments were going on. To determine if other insects aid in clover pollination would require more extensive observation and experiment.

MATURING OF WILD OATS.

Some experiments on wild oats were not so complete as was desired but two or three important points were established. Two questions often asked are: At what age does the wild oat plant become ma-

ture enough so that (a) the seed will grow, and (b) so that the ripe seed will naturally fall from the plant? By keeping record of individual flowers it was found that wild oat grains were ripe enough to grow eighty-five days from seeding and only eight days after blossoming (*anthesis*). The ripe wild oat grains fell to the ground fifteen days after blossoming or 92 days from seeding. It is extremely probable that this time would have been shortened in a quicker season than the one of 1904. As the average time for the maturing of wheat at the station is 100 days, it is at once seen that the wild oat is very certain to seed itself however early the wheat might be cut.

L. R. WALDRON.

THE WORK ON FLAX.

The work with the flax plant has been continued along a number of lines, all looking toward circumventing the soil trouble arising from the flax wilt disease described in Bulletins Nos. 50 and 55.

During the season of 1903 the writer was sent by the board of trustees and the U. S. department of agriculture to Europe to study the diseases of flax, the methods of culture and to procure seed for trial at the different experiment stations.

We have had some 240 odd of these samples of flax under trial this year for two purposes: (1) A comparative study on varieties, and (2) to test their resistance to the wilt diseases. This work will be reported upon in a special publication or bulletin.

The Development of Immunity in Flax.—In our bulletin No. 55 it was shown that there is an open chance of procuring strains of flax which shall be entirely immune to the action of the wilt diseases. We have followed that work along several lines with a view of ascertaining the cause or source of the immune features. We have believed it due to an accident of heredity selected, but we have now much evidence which indicates that it may be acquired. We are no better able to decide between these two points than when we started, but we have gained many valuable facts for farm practice. There can now be no doubt that strains of flax may be had which will grow on the sickest of flax-sick soils without the loss of a plant. Our original sixty pedigrees strains have now been increased to eighty, and each lot of seed has increased from a few grains to several pounds in certain cases. Some of the strains show pronounced individual qualities. Thus we have fine fibre and seed types and certain of them proved under the trying rust conditions of this year to be practically rust proof. To prevent the experiment getting beyond control, it will now be necessary for us to limit our studies to a few of the best strains. These will be increased as fast as possible, and we hope that we may receive some co-operative aid in this matter from the farmers.

The Maintenance of Immunity.—The important question now seems to be, will immunity last? In the case of immunity to wilt,

FIG. 10. From a photograph made July 8th, showing the growth from three *immune* strains of flax seed developed at the North Dakota Agricultural College, third generation from the individual seed (immunes 21, 18, 17). A check row of common flax was seeded between Nos. 18 and 17. The wilt destroyed all plants in this check. Compare this growth with Fig. 8; it was on the same sort of ground.

the plants show every evidence of gaining in strength year by year when seeded upon sick land. Plants of the third and fourth generations far excel in vitality those of the first and second generations. Time only can properly answer this question. In the meantime we shall soon be ready to distribute seed in small quantities to persons who wish to co-operate with us in extending these experiments. The work this year to aid in the solution of whether immunity will be lasting has been conducted along the following lines:

(1) Can immune strains be obtained from any of the different varieties or strains of flax?

(2) Does flax ever cross fertilize in the open?

(3) Can immunity be transmitted or lost in a cross?

(4) Is immunity lost if the immunized plants are subjected to growth upon disease free soil?

(5) Will it be lost by change of soil characteristics, the disease remaining constant, etc.?

Some of these questions can already be answered, in part, others demand extensive experiments, and, economically speaking, all need the answer which time alone can bring.

Besides the experiments conducted on the grounds of this station, two acres of flax sick soil were rented on section 36 at a point near Buffalo, N. D. This soil was thoroughly flax sick, but of a much lighter, more gravelly texture. The experiments conducted there, as a check on the Fargo trials, confirm the results obtained here in all essential points.

How Immune Flax Was Obtained.—These first immune strains of flax have been obtained by saving the seed from certain selected plants and by persistently placing the seed sowed, year after year, under the highest grade of flax sick conditions which we have been able to produce, by continuous cropping to flax, by the plowing in of diseased flax straw, the use of infected seed, etc. All available samples of flax seed used by us in our breeding trials, whether obtained by simple selection or through crossing are given trial under these harsh conditions. We call this process "Promoting Disease to Eliminate the Weak." Though the work is new, just the reverse of the forcing or giving of extra conditions as usually provided by plant breeders in their trial plots, I believe that the idea of testing new or untried breeding progenies under specially prepared, harsh conditions will soon find much favor among breeders. It is a sure way of eliminating weak and non-disease resistant forms or individuals. In the work of crossing to obtain hardy or resistant forms, this line of work may prove an excellent guide in locating fixed crosses which possess the qualities of hardiness desired.

Respectfully submitted,

HENRY L. BOLLEY,

Botanist.

AGRICULTURAL DEPARTMENT

To Director J. H. Worst:

SIR: In submitting the fifteenth annual report of the agricultural department I take pleasure in stating that the work of the department has been enlarged in its scope and held up to our former standard in quality. The scope of the work in the field of live stock investigation has been considerably extended as a result of the provision which secured the services of Professor W. B. Richards for this department. The addition of an efficient herdsman in the person of Mr. Wm. Lanxon also adds greatly to the possibility of carrying on a higher grade of work. Professor E. G. Schollander resigned his position as assistant in plant breeding and Professor O. O. Churchill, a graduate of the Michigan Agricultural college was chosen to fill the place. Numerous changes among the more expert field men have reduced the working efficiency of our force by making it necessary for my assistants to do much supervisory work in the fields which more experienced help could have been trusted to carry out. Little study in methods of controlling soil moisture has been undertaken owing to the fact that Professor J. C. McDowell has found it necessary to spend the most of his time, which was free from teaching work, in writing a text book upon the subject of elementary agriculture to be used in the public schools of the state. Changes in our force of workers together with such outside features as the preparation of a text book and lecturing to farmers' and teachers' institute audiences greatly reduce the capacity of our force for experiment work. Little investigation can now be undertaken in dairying and farm mechanic lines owing to the loss of permanent workers in these departments.

I can heartily commend the efficiency of the present corps of men employed as assistants in this department. The writer's time has been largely taken up and his efficiency reduced by the aid which it has been necessary to give to assistants who are new in the work. Young men who have not had experience in agricultural teaching, experiment work, and who do not know North Dakota agricultural conditions necessarily require a large amount of direction and aid in carrying out their work.

I wish especially to argue the importance of providing sufficient funds to retain the services of suitably qualified investigators, as new men are always secured at a venture and the ones which are suitably qualified and develop into successful workers should not be lost

by reason of having received compensation which is not commensurate with their value. I would further recommend that the amount of teaching and of outside work be limited, as such appointments will always be met by conscientious workers who take pride in being prompt to appear before audiences and to fulfill public duties, while the less spectacular and even more important work of investigation is allowed to go by default as a result of a shortage in time and energy. I do not recommend an indiscriminate promotion of men, nor do I suggest an immunity from teaching duties on the part of the investigators, but I do wish to emphasize the point that an investigator should not be required to carry one-half as many class room subjects as an academic instructor who has but few outside addresses and articles to prepare and no features of business for the institution to look after. The new and changing nature of the features of the teaching work in agriculture, all of which must be presented either entirely by lectures or by extensive supplements to a poorly adapted text book, make the presentation of these subjects a double tax upon the energies of the instructor and on that account very exhaustive exercises to carry out. My experience and observation in experiment work indicate that little is accomplished by men who cannot carry on their investigations consecutively, or by those who are only allowed the remnant of time remaining after their powers of perception have been dulled by the exhaustive work of instructing a class in some agricultural subject.

The large and rapidly increasing number of young men who apply for instruction in the subjects taught indicate that the instruction work in agriculture is proving satisfactory to them, but its degree of popularity has greatly increased the amount of teaching which must be done, as several of the classes are so large that it is necessary to divide them into two and three sections and require the instructor to repeat his work a second and even third time.

The incidental duties which fall to members of this department in assisting agricultural organizations in the state such as the Grain and Stock Growers' Association, The Farmers' Institute, the Macaroni Wheat Growers' Association and the agricultural instruction in teachers' summer schools make heavy inroads upon the time of all of the men employed in the department. The fact that these men are in such demand is the strongest evidence that can be produced that they are capable, practical and well received by the farmers of the state, and while it is probable that they are making good and advisable use of their time in such work it should be recognized that these enterprises consume much time and energy, and that less results can be expected from them in their specific lines of work in the station and college.

The Edgeley substation has again received considerable attention from the writer during the past year. The work has been considerably extended, but Superintendent Thompson has the details of it

better in hand and requires less of specific direction and aid upon details than formerly, leaving the amount of assistance required little if any greater than last year. The management of the bureau of plant industry of the United States department of agriculture was so favorably impressed by the work of the Edgeley substation that they voluntarily placed a considerable sum of money to further the work in plant breeding, which at your suggestion I had instituted.

The correspondence feature of my work continues nearly uniform, being 1,825 pages for the season of 1904, but the portion of it which I have required of the assistants in this department has greatly increased and has made proportionate inroads upon their time.

The most urgent need of the department is a suitable building for the housing of seeds. Few people realize the loss that the fire which consumed the college barn in 1901 was to the state in the destruction of the seed of good strains. Occasional inroads by mice in unprotected seeds, which with our present facilities can only be stored in sacks, result in the loss or mixing of choice samples of seed which have a hereditary value that may represent the outcome of the best work of expert plant breeding for many years. The value which the improved strains of seed sent out by the experiment station will add to the annual income of this state from an increased yield per acre and without any additional expense will represent millions of dollars. On account of the lack of a suitable storage place the station is at present unable to increase and distribute some of the better seeds which have been bred up.

The co-operative aid supplied by the United States department of agriculture for this work has been more than doubled since my last annual report was handed to you. Such co-operation and confidence should not be placed in jeopardy by a failure to provide for the proper storage of the improved seed after it has been produced. The crop growers of the state have promptly accepted all of the improved strains of seed which the station has offered for distribution. These crop producers have materially aided the department in its study of these grains by promptly reporting the results which they have had from growing it on their farms. Over 200 such letters were sent out five weeks ago and today replies from 70 per cent of them have been received. These letters cover such important features as the yield, grade, stiffness of straw, tendency to lodge, effect of rust, and in all of these points the reports compare the results with the standard strains in the community. Many of these men have supplied a dozen others with seed of the improved strains of seed and thus aid vastly in the distribution of seed, and in the gathering of facts concerning these improved strains.

The plant breeding work needs some additional apparatus, such as an especially constructed threshing machine, and a small experiment flour mill for milling the improved samples of grain to determine their bread making capacity.

This department has carried on a number of other trials which will be reported upon later. Among the experiments which have received attention and upon which no data is submitted herewith are the rotation experiments of the station, feeding trials, with roughage for horses, grain rations for hogs, pasturing trials with sheep and hogs and feeding trials with cattle.

The results of the root studies in field crops and of alfalfa trials are being prepared for publication and will appear in bulletin form at an early date.

PLANT BREEDING.

The work of plant breeding in co-operation with the bureau of plant industry, department of agriculture, Washington, D. C., has been carried on in nearly the same manner as already described in my previous annual reports. I am glad to be able to state, however, that through the liberality of the United States department of agriculture the seed breeding work has been extended and systematized in a way which adds greatly to the value of the work. The awarding of a gold medal to the station upon its exhibit of flax breeding by the Louisiana Purchase Exposition is an indication of the estimate which the jury of awards placed upon the importance and rank of the work accomplished.

The number of plants placed in the plant breeding nursery was increased in almost every line which has heretofore received attention and makes a grand total of 51,000 individual plants. Breeding for high protein content in corn has been continued in conjunction with the chemical department of the station. The following is an itemized list of the number of stocks of the different seeds and of the number of individual plants grown:

Fife, eighteen stocks fixed type	4,500 plants
Blue stem, thirty-six stocks unfixed type	3,400 plants
Cross breds	2,700 plants
Durum	1,400 plants
New, miscellaneous and unfixed types	1,400 plants
Total	13,400 plants
Branching or whorled oats, six stocks fixed types	3,400 plants
Side oats 1 stock, unfixed type	700 plants
Cross breds	100 plants
Total	4,200 plants
Six-rowed barley, four stocks fixed type	2,100 plants
Two-rowed barley	1,800 plants
Total	4,200 plants

Flax bred for fibre	1,400 plants
Flax bred for seed	3,000 plants
Total	4,400 plants
Buckwheat, light colored seed	500 plants
Buckwheat, dark colored seed	1,000 plants
Buckwheat, red type of seed	100 plants
Total	1,600 plants
Millet for seed, twelve stocks	2,800 plants
Millet for fodder	600 plants
Millet for seed and fodder	200 plants
Total	3,600 plants
Alfalfa	2,500 plants
Emmer	400 plants
Speltz	300 plants
Spring rye	300 plants
Ein korn	100 plants
Corn	15,000 plants

The seeds which show the best individual performance in the plant nursery for from three to five years are increased in quantity and placed in the variety trials, where they are compared with all other promising grains of their sort for from three to five years. At the expiration of this preliminary trial of three to five seasons all but five to ten of the best strains are discarded and the highest yielding and grading sorts are either increased in quantity or left in the trials to give further proof of their superiority as producers. The station has moved slowly and cautiously in this matter of distributing improved strains of seed as it seemed advisable to proceed upon a certain and safe basis in placing good strains in the hands of producers, as a single failure sent out by the station during its primary distribution work would cause a great loss of confidence and consequent permanent injury. Whether by reason of the precaution taken or on some other account, the work of the seed distribution by this station has been given a splendid reception by the grain growers of the state, as will be seen by the record which appears in this report.

J. H. Shepperd.

SEED DISTRIBUTION.

The importance of seed distribution is only second to that of variety improvement, as the value which the breeding represents to the state is measured by the degree of distribution which is accorded the superior strains of seeds produced. It has been the policy of the sta-

Grading grain—plant breeding work of the Experiment Station.

Grown from Experiment Station pedigreed seed wheat.

tion to distribute the seed by sale which has proven valuable for this district. It was the judgment of Director Worst and the head of this department that a purchase price would bar those who are clamerous for gifts, but who fail to take products which cost them something, and who seldom do much with good strains when they have them. During the experimental stages with brome grass it was the policy of the station to distribute small packages of it free in order that it might be given a trial under the many varying conditions represented by the different parts of this state. After time enough had elapsed for a reasonable judgment to be based upon the trial, letters asking for results were sent to the persons who had received seed from this institution. The twelfth annual report of the station, pages 82 to 85, gives the results from their co-operation. One hundred reports, embodying the judgment of as many practical growers from different localities in the state of North Dakota, is evidence that the co-operation was genuine, and that a mass of data was collected which the station could not have secured unaided in a decade of time and with a heavy outlay of funds.

Another valuable feature is that the station supplied a start of pure brome grass seed to over 350 farmers by means of this distribution.

At the beginning of the work of disseminating improved strains of small grain, which the station had collected and bred up, a half bushel of the seed of North Dakota No. 66 wheat was sold to each wheat grower desiring it at $1 for thirty pounds, which price included the grain sack in which the seed was shipped. Many of our best wheat growers protested that a half bushel sample was too small to bother with and in response to their request the quantity supplied to a single grower was raised first to five bushels and later to ten bushels, where the amount of a single variety of grain on hand at the station would permit sending it out in that quantity.

The station has charged from $1 to $1.25 per bushel for seed wheat, 75 cents per bushel for oats and barley, and $2 to $2.50 per bushel for seed corn sent out. It has been the policy of the station to quit distributing seed grain as soon as the persons to whom it was sent were prepared to supply the demand, and thus give them the pecuniary advantage due them for their faith and trouble in caring for and reporting upon the new things sent out. Occasionally, after the seed of a new sort has become plentiful and the station has felt that it could sell a quantity of seed without being unfair to farm seed producers, it has sold a quantity of seed to a single individual as will be noted in the above report. That the plan of distributing seed grain in a little larger quantity than was first planned is a satisfactory method is evidenced by an average of about 75 per cent of the persons who have received seed from the station having returned reports upon their success with the grain, grass or other field crop purchased from the institution. Farmers who work into these improved strains of grain are urged to charge about the same price that the station

has done for the seed, and it has been gratifying to the station workers to find that it is possible to refer persons inquiring for seed of the particular strains sent out by the institution at earlier dates to men in their own counties in nearly every instance in recent years. Agricultural colleges and experiment stations are promptly criticised as being unfair when they compete with seed men and stock breeders by selling improved grain and live stock, and they are doubly censured when they sell improved animals and seeds at prices below those prevalent for their grade and pedigree in the hands of the commercial breeders of improved field seeds and farm animals.

This station has thus far been free from that criticism in so far as the head of this department has been able to learn, and that is certainly a point which is worth much to the station. The station authorities have been charged with being too deliberate about sending out new strains of seed, but the policy has been to lose a year or two and be doubly sure rather than take a chance of sending out a strain of seed which will not prove valuable. The following list of names and postoffice addresses will enable the reader to trace the original source of seed sent out by the North Dakota Experiment Station prior to 1905:

BROME GRASS, 1897.

		LBS.
1.	Allin, Rodger, Grafton, N. D.	½
2.	Bergster, Jesse, Jamestown, N. D.	½
3.	Hovde, Ole O., Hillsboro, N. D.	½
4.	Lidstrom, Chas., Glen Ullin, N. D.	½
5.	Nichols Brothers, Oakes, N. D.	½
6.	Picard, Warren, Niagara, N. D.	½
7.	Power, J. A., Power, N. D.	1
8.	Reid, Jas., Courtenay, N. D.	1
9.	Roberts, G. S., Dawson, N. D.	½
10.	Russell, B. S., Jamestown, N. D.	½
11.	Smith, Geo. M., Pingree, N. D.	½
	Total for 1897	6.5

BROME GRASS, 1898.

		LBS.
1.	Adams, T. L., New Rockford, N. D.	1
2.	Allen, W. B., Jamestown, N. D.	1
3.	Allin, Rodger, Rodger, N. D.	1
4.	Anderson, P. B., Manfred, N D.	1
5.	Anson, A. M., Casselton, N. D.	1
6.	Anton, Wilman, Niagara, N. D.	1
7.	Ausenhus, Aug., Eden, N. D.	1
8.	Barry, Wm., Niagara, N. D.	1

		LBS.
9.	Bailey, S. H., New Rockford, N. D.	1
10.	Bryant, Ed., Napoleon, N. D.	1
11.	Clark, Wm., Maza, N. D.	1
12.	Cordes, Henry, Sawyer, N. D.	1
13.	Curry, N. E., Colgate, N. D.	1
14.	DeSautel, David, Grafton, N. D.	1
15.	Gluyas, W. R., Hofflund, N. D.	1
16.	Graham, W. J., Grafton, N. D.	1
17.	Foley, J. W., Medora, N. D.	25
18.	Homer, H. N., Sherbrooke, N. D.	1
19.	Johnson, Aug. E., Washburn, N. D.	1
20.	Johnson, B. S., Pembina, N. D.	1
21.	Kirk Brothers, Niagara, N. D.	1
22.	Knoke, L. A., Willow City, N. D.	1
23.	Kurtz, S. E., Emmons Co., N. D.	1
24.	Lattin, Wm., Towner, N. D.	1
25.	Ludvig, Wm., Penn, N. D.	1
26.	Lyons, P. J., Steele, N. D.	1
27.	Matthews, J. H., Larimore, N. D.	1
28.	Murphy, J. S., Minot, N. D.	1
29.	Oliver, Harry, Lisbon, N. D.	1
30.	Olson, J. R., Finley, N. D.	1
31.	Plain, Chas., Milton, N. D.	1
32.	Piper, Ferd., Addison, N. D.	1
33.	Robertson, Geo., Niagara, N. D.	1
34.	Robinson, Geo. L., Coal Harbor, N. D.	1
35.	Schiller, Joseph, Great Bend, N. D.	1
36.	Simpson, M. L., Steele, N. D.	2
37.	Starley, W., Nicholson, N. D.	1
38.	Thompson, J. M., Ayr, N. D.	1
39.	Thomas, H. U., Bismarck, N. D.	1
40.	Thorson, T., Bellville, N. D.	1
41.	Tyson, Robert A., Hankinson, N. D.	1
42.	Underwood, W. B., Rolla, N. D.	1
43.	Welsh, G. A., Bismarck, N. D.	1
44.	Wishek, J. H., Ashley, N. D.	1
	Total for 1898	69

BROME GRASS, 1899.

		LBS.
1.	Alderson, Thos., Rolla, N. D.	1
2.	Alexander, J., Sharlow, N. D.	1
3.	Anderson, Peter, Carrington, N. D.	1
4.	Atkinson, J. A., Sykeston, N. D.	1

		LBS.
5.	Ayrea, W. M., Cooperstown, N. D.	1
6.	Ayres, M. L., Dickinson, N. D.	1
7.	Backen, Geo., Larrabee, N. D.	1
8.	Bailey, E. E., Perth, N. D.	1
9.	Bailey, N. B., Perth, N. D.	1
10.	Bates, H. D., Park River, N. D.	1
11.	Baum, Mr., Edgeley, N. D.	1
12.	Bentley, John, Barton, N. D.	1
13.	Bergman, John S., Gardar, N. D.	1
14.	Berry, Chas., Rolla, N. D.	1
15.	Bethke, L., Edgeley, N. D.	1
16.	Bonlieger, R., Grass Lake, N. D.	1
17.	Bork, Frederick, Edgeley, N. D.	1
18.	Baurassa, A. N., St. John, N. D.	1
19.	Bowers, N. R., Rolla, N. D.	1
20.	Brandwold, K. T., Edinburg, N. D.	1
21.	Brothseth, A., Dwight, N. D.	1
22.	Brown, J. A., Mars, N. D.	1
23.	Brown, Newton, Sharlow, N. D.	1
24.	Bryan, D. S., Taylor, N. D.	1
25.	Butler, F. C., Holmes, N. D.	1
26.	Butts, R. C., Sykeston, N. D.	1
27.	Calberg, Chas., Carrington, N. D.	1
28.	Carey, A. T., Lidgerwood, N. D.	1
29.	Carey, E. W, Lidgerwood, N. D.	1
30.	Carlyle, A. M., Towner, N. D.	1
31.	Carpenter, Sam, Barton, N. D.	1
32.	Carter, N., Sykeston, N. D.	1
33.	Casenden, F., Leeds, N. D.	1
34.	Ceruden, M. O., Barton, N. D.	1
35.	Christianson, Peter, Taylor, N. D.	1
36.	Christianson, Th. T., Gardar, N. D.	1
37.	Chutz, C., Edgeley, N. D.	1
38.	Cleveland, C. F., Twala, N. D.	1
39.	Comeelie, W .W., Edgeley, N. D.	1
40.	Cone, W. H., Petersburg, N. D.	1
41.	Castello, Robt., Picton, N. D.	1
42.	Coulter, Wm., Medford, N. D.	1
43.	Cripe, Isaac, York, N. D.	1
44.	Cummings, John, Devils Lake, N. D.	1
45.	Cunningham, Mr., Dash, N. D.	1
46.	Dahl, M. O., Barton, N. D.	1
47.	Dawnham, Henry, Sykeston, N. D.	1
48.	Decker, D., Edgeley, N. D.	1
49.	Deihl, N., Edgeley, N. D.	1
50.	Dennis, W. H., Edgeley, N. D.	1

		LBS.
51.	Dixon, Arthur, Rolla, N. D.	1
52.	Drenth, Christian, Edgeley, N. D.	1
53.	Dumphrey, Jas., Rolla, N. D.	1
54.	Duncan, R. F., Sharon, N. D.	1
55.	Ecks, Nick, Great Bend, N. D.	1
56.	Edwards, David, Picton, N. D.	1
57.	Emig, H. J., Edgeley, N. D.	1
58.	Epton, S. E., Rolla, N. D.	1
59.	Fenburg, Martin, Sykeston, N. D.	1
60.	Ford, I. J., Arvilla, N. D.	1
61.	Gailfus, Hugo, Rolla, N. D.	1
62.	Gailfus, Walter, Rolla, N. D.	1
63.	Galliger, J. H. ,Lawrence, N. D.	1
64.	Gardner, B. H., Lsbon, N. D.	50
65.	Gardner, F. C., Lisbon N. D.	50
66.	Gaxton, F., Rolla, N. D.	1
67.	Gemmill, J. A., Sylvista, N. D.	1
68.	Gilmord, Geo. A., Barton, N. D.	1
69.	Gjewa, O. J., Soper, N. D.	1
70.	Goff, Ed., Beaulieu, N. D.	1
71.	Goozee, W. E., Devils Lake, N. D.	1
72.	Graham, R. A., Island Lake, N. D.	1
73.	Grant, A., Rolla, N. D.	1
74.	Green, B. F., Park River, N. D.	1
75.	Gregg, Geo. D.,	1
76.	Grest, Nick, Leonard, N. D.	1
77.	Greston, John, Picton, N. D.	1
78.	Gundmundur, Eliason, Cavalier, N. D.	1
79.	Guseck, G., Bandon, N. D.	1
80.	Hagendorf, A. F., Dunseith, N. D.	1
81.	Hayley, Alfred, Leeds, N. D.	1
82.	Hamilton, R., Rolla, N. D.	1
83.	Hamman, Carl, Rchardton, N. D.	1
84.	Hamman, Fred, Richardton, N. D.	1
85.	Hammond, Ben, Willow City N, D.	1
86.	Hanson, C. A., Towner, N. D.	1
87.	Harding, Harry, Sykeston, N. D.	1
88.	Harris, Albert, Walcott, N. D.	1
89.	Haskell, F. A., Cooperstown, N. D.	1
90.	Hegeland, Martin, Lee, N. D.	1
91.	Hegelson, H. T., Milton, N. D.	1
92.	Henderson, A. F., Rolla, N. D.	1
93.	Hickethein, J. M., West Lake, Idaho	1
94.	Hillet, Wm., Hoople, N. D.	1
95.	Hinebauch, T. D., Tower City, N. D.	50
96.	Hintz, C., Harvey, N. D.	1

		LBS.
97.	Hochsletter, G. J., Grass Lake, N. D.	1
98.	Hoffman, O. S., Mannhaven, N. D.	1
99.	Hagenson, John, Romners, N. D.	1
100.	Honey, C. H., Park River, N. D.	1
101.	Hoppe, Hermann, Sykeston, N. D.	1
102.	Hulsenbus, Albert, Sykeston, N. D.	1
103.	Iudridson, C., Mountain, N. D.	1
104.	Irwin, R. E., Rugby, N. D.	1
105.	Jack, D., Page, N. D.	1
106.	James, J. K., Sidney, N. D.	1
107.	Jeffere, W. H., York, N. D.	1
108.	Johnson, O. P., Abercrombie, N. D.	1
109.	Johnson, Herman, Mars, N. D.	1
110.	Jolliffe, Jno., Rolla, N. D.	1
111.	Jolliffe, H. O., Rolla, N. D.	1
112.	Jufte, John, Northwood, N. D.	1
113.	Kingsbury, N., Leeds, N. D.	1
114.	Kitts, F. J., Rolla, N. D.	1
115.	Kopson, T. C., Mayville, N. D.	1
116.	Koto, S. M., Villard, N. D.	1
117.	Kutz, A., Sykeston, N. D.	1
118.	Lamach, J. W., Park River, N. D.	1
119.	Langdon, W. N., Rugby, N. D.	1
120.	Langsjon, J. M., Edgeley, N. D.	1
121.	Laird, R. J., Perth, N. D.	1
122.	Larson, Knud, Leeds, N. D.	1
123.	Larson, Louis A., Rugby, N. D.	1
124.	Larson, Peter A., Towner, N. D.	1
125.	Latter, Wm., Sidney, N. D.	1
126.	Leslie, Hugh, Rolla, N. D.	1
127.	Levite, Jas., Ferdinand, Idaho	1
128.	Lewis, L. L., Taylor, N. D.	1
129.	Lindburg, G. J., Bottineau, N. D.	1
130.	Lockhart, J. W., Towner, N. D.	1
131.	Londesborough, S. H., Park River, N. D.	1
132.	Long, J. A., Finley, N. D.	1
133.	Long, F. W., Cando, N. D.	1
134.	Londenslager, S. F., Sykeston, N. D.	1
135.	Ludvig, Lee, Fingal, N. D.	1
136.	Madson, Fred, Taylor, N. D.	2
137.	Malony Bros., Rolla, N. D.	1
138.	Mann, W. B., Sykeston, N. D.	1
139.	Martin, F. H., New Rockford, N. D.	1
140.	Maxwell, G. S., Sykeston, N. D.	1
141.	McCaerssick, Adam, Rugby, N. D.	1
142.	McCauly, Jas., Park River, N. D.	1

		LBS.
143.	McCeury, Thos., Carrington, N. D.	1
144.	McGuire, S. O., Engineer, N. D.	1
145.	McKenna, H., St. John, N. D.	1
146	McKennart, H. J., Rolla, N. D.	1
147.	McKissick, Chas., Mayville, N. D.	1
148.	McIlvian, W. W., Lisbon, N. D.	50
149.	McManus, Jas., St. John, N. D.	1
150.	Miller, C. J., Sykeston, N. D.	1
151.	Miller, A. F., Wagar, N. D.	1
152.	Miller, F. R., Grass Lake, N. D.	1
153.	Miller, J. D., Rolla, N. D.	1
154.	Monzer, S. O., Minot, N. D.	1
155.	Milne, Wm., Park River, N. D.	1
156.	Merrigen, M. M., Conway, N. D.	1
157.	Morroe, T. W., Cecil, N. D.	1
158.	Mullet, J. J., St. John, N. D.	1
159.	Mulroy, J. H., Hannaford, N. D.	1
160.	Nelson, Chas., Leeds, N. D.	1
161.	Nortky, W. H., Wyndmere, N. D.	1
162.	Ness, H. S., Knox, N. D.	1
163.	Newell, Thos., Hope, N. D.	8
164.	Newton, C. H., Harwood, N. D.	2.
165.	O'Donnell, J. T., Picton, N. D.	1
166.	O'Meale, R. A., Neche, N. D.	1
167.	O'Neil, J. E., Fessenden, N. D.	1
168.	Olson, P. A., Barton, N. D.	1
169.	Packard, R. A., Rolla, N. D.	1
170.	Patterson, Omer, Rolla, N. D.	1
171.	Pedley, L. S., Edgeley, N. D.	1
172.	Peterson, C. P., Bisbee, N. D.	1
173.	Peterson, H. A., Bowden, N. D.	1
174.	Peterson, Ole E., Rolla, N. D.	1
175.	Pettibone, Mr., Dawson, N. D.	6
176.	Plott, Jas., Edgeley, N. D.	1
177.	Pond, Lewis, Church's Ferry, N. D.	1
178.	Powers, Sanford, Ogallah, Kansas	2
179.	Reno, J. K., Grass Lake, N. D.	1
180.	Risk, J. A., Edgeley, N. D.	1
181.	Rishel, Dr. E., Tower City, N. D.	50
182.	Robb, Fred, Park River, N. D.	1
183.	Robb, Chas., Soper, N. D.	1
184.	Rodal, Anton, Barton, N. D.	1
185.	Rodke, Carl, Manfred, N. D.	1
186.	Rogers, Will, Rolla, N. D.	1
187.	Rom, O. C., Wilmot, N. D.	1
188.	Rawley, A. D., Edgeley, N. D.	1

		LBS.
189.	Russel, W. S., Rugby, N. D.	1
190.	Sand, Martin, Rugby, N. D.	1
191.	Saunders, A., Cooperstown, N. D.	1
192.	Schneider, D., Medford, N. D.	1
193.	Schnell, C. P., Island Lake, N. D.	1
194.	Schulz, J. O., Hurricane Lake, N. D.	1
195.	Scott, L., Taylor, N. D.	1
196.	Scripture, W. F., St. John, N. D.	1
197.	Shepperd, J. W., Chariton, Iowa	1
198.	Shurman, B. L., Rugby, N. D.	1
199.	Simpkins, R. W., Leeds, N. D.	1
200.	Swenson, Isaac, Leeds, N. D.	1
201.	Smote, W. W., Perth, N. D.	1
202.	Smith, J. O., Casselton, N. D.	50
203.	Smyth, Jas., Verona, N. D.	1
204.	Steele, Benj., Ferdinand, Idaho	1
205.	Stafne, E., Galchut, N. D.	1
206.	Sumner, A. F., Rolla, N. D.	1
207.	Svalestnen, K., Hillsboro, N. D.	1
208.	Swift, M., Leeds, N. D.	1
209.	Taylor, Sam, Wahpeton, N. D.	1
210.	Thompson, J. K., Walcott, N. D.	1
211.	Thoreson, O. J., Park River, N. D.	1
212.	Topping, T. H., Auburn, N. D.	1
213.	Travis, W. B., Rolla, N. D.	1
214.	Tufts, D. E., Sharon, N. D.	1
215.	Tweeten, O. S., Thompson, N. D.	1
216.	Tyler, M. M., Edgeley, N. D.	1
217.	Ulayo, H. A., Walhalla, N. D.	1
218.	Umving, John, Devils Lake, N. D.	1
219.	Van Kleeck, Mr., Detroit, Minn.	1
220.	Ward, Stewart, Rolla, N. D.	1
221.	Waring ,Richard, Rolla, N. D.	1
222.	Watt, S., Dash, N. D.	1
223.	Watts, J. T., Rugby, N. D.	1
224.	Weaver, G., Edgeley, N. D.	1
225.	Weirick, E. D., Grass Lake, N. D.	1
226	Welter, N. P., Acton, N. D.	1
227.	Widmeyer, Gindo, Rolla, N. D.	1
228.	Widmeyer, Staus, Rolla, N. D.	1
229.	Williams, T. A., Sharlow, N. D.	1
230.	Wood, Allen, Rolla, N. D.	1
231.	Wright, Arthur, Sidney, N. D.	1
232.	Ward, Ralph D., Roach, N. D.	1
233.	Whimee, M. S., Millthrope, New South Wales	1

		LBS.
234.	Wnelndee, Ole, Minot, N. D.	1
235.	Ziegber, S. D., York, N. D.	1
	Total for 1899	494

BROME GRASS, 1900.

		LBS.
1.	Armick, A. H., Minot, N. D.	1
2.	Amland, C., Emrich, N. D.	1
3.	Baarken, G. J., Larrabee, N. D.	1
4.	Benden, J. M., Harwood, N. D.	1
5.	Berseth, C. M., Sperry, N. D.	1
6.	Blose, Geo. A., Cando, N. D.	50
7.	Bradford, John ,Courtenay, N. D.	1
8.	Briscoe, C. A., Harwood, N. D.	1
9.	Bance, W. A., Kempton, N. D.	15
10.	Carnine, F. A., Harwood, N. D.	1
11.	Dejoe, J. W., Fairmount, N. D.	50
12.	Dybing, T., Harvey, N. D.	1
13.	Edgelaand, P. J., Harvey, N. D.	1
14.	Erickson, Julius, Ashley, N. D.	1
15.	Fatland, Peter, Walcott, N. D.	15
16.	Garbutt, J. A., Fargo, N. D.	1
17.	Green, J. L., Sheldon, N. D.	1
18.	Griffith, Jas., Larimore, N. D.	1
19.	Guy, Arthur P., Wishek, N. D.	1
20.	Hardenburg, Peter, Willow City, N. D.	1
21.	Harrison, O. H., Blanchard, N. D.	1
22.	Harvey, J., Walhalla, N. D.	1
23.	Hestdalen, Lars, Abercrombie, N. D.	1
24.	Hoag, S. V., Harwood, N. D.	1
25.	Ingler, J. G., Abercrombie, N. D.	1
26.	Jaahnke, Paul, Everest, N. D.	1
27.	Jeffrey, J. A., Michigan, A. C.	1
28.	Jensen, Andrew, Buffalo, N. D.	1
29.	Jenson, Fred, Buffalo, N. D.	1
30.	Johnson, C. M., Dwight, N. D.	50
31.	Kange, Tom S., Christine, N. D.	1
32.	Kribler, C. M., Wimbledon, N. D.	50
33.	Kragness, J., Christine, N. D.	1
34.	Kuber, A. L., Adler, N. D.	1
35.	Lewis Clarence, Rolla, N. D.	1
36.	Lindahl, Anton, Powers, N. D.	1
37.	Longfellow, G. J., Buxton, N. D.	1
38.	Lardakken, O. C., Homstad, N. D.	1

		LBS.
39.	Ludvig, Wm., Penn, N. D.	1
40.	Marcotte, J. L., Rolla, N. D.	1
41.	Meilicke, Edw., Wheatland, N. D.	50
42.	Merritt, C. E., Courtenay, N. D.	1
43.	Meyers, Jno. J., Mountain, N. D.	1
45.	Montgomery, T. C., Harvey, N. D.	8
46.	Murphy, J. W., Walhalla, N. D.	1
47.	Omlie, Swan, Osgood, N. D.	1
48.	Page, Geo. J., Harvey, N. D.	16
49.	Perry, Wm., Fargo, N. D.	2
50.	Peters, Geo. J., Rolla, N. D.	1
51.	Peters, Melville, Rolla, N. D.	1
52.	Pierce, A. F., Wimbledon, N. D.	100
53.	Powell, R. J., Cando, N. D.	50
54.	Rueston, J. M., Argusville, N. D.	50
55.	Randall, F. E., Ludden, N. D.	1
56.	Rasmussen, Nels P., Valley City, N. D.	50
57.	Richards, E. H., Willow City, N. D.	1
58.	Sanford, C. A., Courtenay, N. D.	1
59.	Schmeling, F., New Salem, N. D.	1
60.	Shear, J. M., Buxton, N. D.	1
61.	Skaar, E. L., Courtenay, N. D.	1
62.	Slethany, Mr. Kindred, N. D.	1
63.	Setten, Ole B., Stanley, N. D.	1
64.	Standiford, E. S., Gladstone, N. D.	35
65.	Sykes, E. H., Stanley, N. D.	1
66.	Thomas, A. W., Seymour, N. D.	50
67.	Walsh, John, Harvey, N. D.	1
68.	Walter, J. S., Acton, N. D.	1
69.	Watt, Robt., Tower City, N. D.	1
70.	Willison, S. D., Blanchard, N. D.	1
	Total for 1900	624.

BROME GRASS, 1903.

		LBS.
1.	Barkus, C. A., Fargo, N. D.	3
2.	Boman, S., Fargo, N. D.	97
3.	Bye, John O., Hexom, N. D.	130
	Total for 1903	230

SLENDER WHEAT GRASS, 1903.

		LBS.
1.	Christenson, John, Mandan, N. D.	75
2.	Flewell, H. E., Wimbledon, N. D.	75

		LBS.
3.	Knoke, L. A., Willow City, N. D.	75
4.	Pond Lewis, Church's Ferry, N. D.	75
5.	Sykes, R., Sykeston, N. D.	75
	Total for 1903	375

NORTH DAKOTA NO. 66 WHEAT, 1897.

		BUS.
1.	Benedct, Dr. A. V., Emrich, N. D.	1
2.	Boyd, E. L., Bue, N. D.	½
3.	Brand, Sam, Taylor, N. D.	½
4.	Bronley, S. J., Nicholson, N. D.	½
5.	Brundage, F. B., Dawson, N. D.	½
6.	Bue, J. F., Bue, N. D.	½
7.	Bue, L. O., Bue, N. D.	½
8.	Casey, L. R., Melville, N. D.	1
9.	Fredrckson, Julius ,Kensal, N. D.	½
10.	Guslander, L. W., Kensal, N. D.	½
11.	Hovde, Jr., Ole O., Hillsboro, N. D.	½
12.	Jorgenson, Andrew, McCanna, N .D.	½
13.	Larnson, Sam, Bue, N. D.	½
14.	Lorenson, G., Casselton, N. D.	1
15.	McKay, Neil, Gardner, N. D.	½
16.	McLachler, Peter, Hunter, N. D.	1
17.	Montgomery, W. F., Christine, N. D.	½
18.	Neshem, K. O., Bue, N. D.	½
19.	Olsen, Gilbert, Fingal, N. D.	2
20.	Porter, A. W., Adrian, N. D.	1
21.	Root, Herbert, Valley City, N. D.	½
22.	Rurck, Nick, Leonard, N. D.	2
23.	Wikey, R., Sykeston, N. D.	½
24.	Webster, C. E., Fargo, N. D.	½
	Total for 1897	17½

NORTH DAKOTA NO. 66 WHEAT, 1898.

		BUS.
1.	Farnham, G. S., Carrington, N. D.	50
2.	Robinson, J. J., Coal Harbor, N. D.	2
3.	Smith, J. O., Casselton, N. D.	20
	Total	72

NORTH DAKOTA NO. 66 WHEAT, 1899.

		BUS.
1.	Anderson, Alf. J., Hillsboro, N. D.	2
2.	Armstrong, H. A., Williamsport, N. D.	8
3.	½ of this for a neighbor	
4.	Bergman, E. H., Gardar, N. D.	5
5.	Bergman, Jonas S., Gardar, N. D.	5
6.	Bryan, D. S., Taylor, N. D.	5
7.	Capiton, Louis, Neche, N. D.	3
8.	Christianson, Th. T., Hillsboro, N. D.	2
9.	Davis, J. A., Buxton, N. D.	20
10.	Else, James, Hurricane Lake, N. D.	4
11.	Goff, Ed., Beaulieu, N. D.	2
12	Hart, C. H., Jolliette, N. D.	1
13.	Hinish, Geo., Edgeley, N. D.	5
14.	Johnson, B., Gardar, N. D.	4
15.	Knoke, L. A., Willow City, N. D.	5
16.	Lee, T. J., Fingal, N. D.	1
17.	Madson, Fred, Taylor, N. D.	5
18.	Pepper, W., Edgeley, N. D.	5
19.	Starr, C. E., Dawson, N. D.	1
20.	Welch, Geo. A., Bismarck, N. D.	1
21.	Whitmere, M. S., New South Wales	.
	Total for 1899	84

NORTH DAKOTA NO. 66 WHEAT, 1900.

		BUS.
1.	Appert, Martin, Williamsport, N. D.	4
2.	Cocks, J. S., Larimore, N. D.	5
3.	Eastgate, T. F., Larimore, N. D.	5
4.	Henderson, Thos., Rolla, N. D.	2
5.	Hill, E. L. Hesper, N. D.	2
6.	Isenberger, A. G., LaMoure, N. D.	5
7.	Kressmer, Wilhelm, Bisbee, N. D.	5
8.	Lewis, F. D., Bordulac, N. D.	5
9.	Moore, Chas., Cashel, N. D.	2
10	Murehouse, Jas., Langdon, N. D.	5
11.	Oium, T. N., Lisbon, N. D.	2
12.	Olson, John K. ,Jessie, N. D.	5
13.	Pond, Lewis, Church's Ferry, N. D.	2
14.	Powers, Simon, Casselton, N. D.	5
15.	Stanford, L. C., Kelso, N. D.	10
16.	Swambjormson, Mountain, N. D.	5
17.	Thorwaldson, Elias, Mountain, N. D.	5
18.	Thorwaldson, Stig., Akra, N. D.	5

		BUS.
19.	Watkins, Byron, Devils Lake, N. D.	2
20.	Watson, Robt., Langdon, N. D.	5
21.	Weaver, G., Edgeley, N. D.	5
22.	White Brothers, Valley City, N. D.	5
23.	Wild, Peter, Osnabrock, N. D.	5
	Total for 1900	101

NORTH DAKOTA NO. 66 WHEAT, 1901.

		BUS.
1.	Dawson, G. V,, Havana, N. D.	2
2.	Mundy, James, Rolla, N. D.	5
3.	Pond, Lewis, Church's Ferry, N. D.	5
4.	Strom, O. L., Oberon, N. D.	5
	Total for 1901	17

MINNESOTA NO. 163 WHEAT, 1900.

		BUS.
1.	Allin, Roger, Grafton, N. D.	2
2.	Anderson, Ed. M., Walhalla, N. D.	2
3.	Backer, Mr., Langdon, N. D.	2
4.	Bergman, E. H., Gardar, N. D.	2
5.	Bliss, C. L., Buffalo, N .D.	5
6.	Bolton, Thos., Park River, N. D.	2
7.	Brindle, S. E., Williamsport, N. D.	2
8.	Christianson, Th. T., Gardàr, N. D.	2
9.	Clark, Chas., Eldridge, N. D.	2
10.	Davis, J. A., Buxton, N. D.	2
11.	Dunlap, Chas., Michigan City, N. D.	2
12.	Eastgate, T. F., Larimore, N. D.	2
13.	Hinebauch, T. D., Tower City, N. D.	2
14.	Lewis, R. S., Buffalo, N. D.	2
15.	Lewis, R. S. (1901), Buffalo, N. D.	5
16.	McInnis, Murdock, Edgeley, N. D.	2
17.	Nelson, Magnus, Lisbon, N. D.	2
18.	Oium, T. N., Lisbon, N. D.	2
19.	Powers, S. C., Casselton, N. D.	2
20.	Schollander, E. G., Montpelier, N. D.	2
21.	Smith, Datus, Blanchard, N. D.	2
22.	Ueland, L. A., Edgeley, N. D.	2
23.	White, Frank, Valley City, N. D.	5
24.	Will, Oscar, Bismarck, N. D.	2
	Total for 1900	57

MINNESOTA NO. 163 WHEAT, 1901.

		BUS.
1.	Anderson, O. F., Christine, N. D.	4
2.	Beeber, R. F., Berlin, N. D.	5
3.	Beltz, P. J., Buxton, N. D.	5
4.	Billings, P. M., Lisbon, N. D.	10
5.	Clark, Chas Eldridge, N. D.	4
6.	Cooper, J. R., Emerado, N. D.	5
7.	Corbet, John, Crystal, N. D.	5
8.	Dawson, G. V., Havana, N. D.	2
9.	Eggen, Brothers, Fargo, N. D.	20
10.	Ellis, T. C., Anamoose, N. D.	5
11.	Fiadet, John, Edgeley, N. D.	5
12.	Garder, O. G., Grafton, N. D.	5
13.	Goehl, Herman LaMoure, N. D.	5
14.	Greenwood, W. J., Hensel, N. D.	5
15.	Grest, Nick, Leonard, N. D.	5
16.	Grest, J. P., Leonard, N. D.	5
17.	Hinish, Geo., Edgeley, N. D.	5
18.	Knight, J. E., Galesburg, N. D.	5
19.	Leech, A., Addison, N. D.	7 4-5
20.	Martin, C., Crystal, N. D.	4½
21.	Mattson, M. G., LaMoure, N. D.	5
22.	McInnis, Murdoch, Edgeley, N. D.	5
23.	Mundy, James, Rolla, N. D.	5
24.	Peterson, P. T., Grafton, N. D.	2
25.	Pierce, Dexter, Larimore, N. D.	5
26.	Pond, Lewis, Church's Ferry, N. D.	5
27.	Porter, John, Hoople, N. D.	5
28.	Porter, Thos., Gilby, N. D.	5
29.	Rasmussen, M., Kenmare, N. D.	4
30.	Strom, Ole, Oberon, N. D.	5
31.	Szarkowiski, G. M., Grafton, N. D.	5
32.	Young, Geo., Berlin, N. D.	5
33.	Young, Fred, LaMoure, N. D.	5
34.	Young, John, Berlin, N. D.	5
	Total for 1901	184

MINNESOTA NO. 163 WHEAT, 1902.

		BUS.
1.	Anderson, Andrew ,Christine, N. D.	5
2.	Armstrong, Thos., Glasston, N. D.	5
3.	Ashbrook, Owen E., Larimore, N. D.	5
4.	Aslackson, H. R., Edmore, N. D.	10
5.	Baetz, Henry, Anamoose, N. D.	1
6.	Bates, A. C., Donnybrook, N. D.	5

		BUS.
7.	Beighle, M. N., Velva, N. D.	1
8.	Bjorndaahl, N. N., Balfour, N. D.	1½
9.	Bohnsack, J. D., Rock Lake, N. D.	4
10.	Brown, E. J., Kenmare, N. D.	5
11.	Fatland, Even H., Walcott, N. D.	5
12.	Fjelstad, E. M., Forman, N. D.	1¾
13.	Fisher, C. M., Devils Lake, N. D.	5
14.	Gillies, Chas., Crystal, N. D.	5
15.	Hagen, Ole S., Crary, N. D.	1
16.	Hendrickson, C., Grafton, N. D.	5
17.	Langworthy, D. A., Carnine, N. D.	15
18.	Larimore, Clay, Larimore, N. D.	5
19.	Larson, Knud, Gilby, N. D.	5
20.	Olson, Ole S., Grafton, N. D.	2½
21.	Omang, B., Mekinock, N. D.	5
22.	Owen, C. G., Larimore, N. D.	5
23.	McCarthy, John, Neche, N. D.	10
24.	Meyer, F. P., Rugby, N. D.	5
25.	Mulroy, J. H., Hannaford, N. D.	5
26.	Paulson, J. H., Hoople, N. D.	½
27.	Pederson, Edward, Hatton, N. D.	10
28.	Preston, C. W., Blanchard, N. D.	5
29.	Speisman, John, Devils Lake, N. D.	5
30.	Smith, Hayward, St. Thomas ,N. D.	15
31.	Stovens, Arne T., Veseleyville, N. D.	20
32.	Walton, J. L., St. Thomas, N. D.	10
33.	Weber, Robt., Conger, N. D.	5
	Total for 1902	193¼

DURUM OR MACARONI WHEAT VARIETIES, 1902.

		BUS.
1.	Aslaskson, H. R., Edmore, N. D., Black Don.	5
2.	Baetz, Henry, Anamoose, N. D., Velvet Don.	1
*3.	Bergman, E. H., Gardar, N. D.	1
*4.	Davis, J. A., Buxton, N. D.	10
*5.	Douglas, S., St. Thomas, N. D.	10
6.	Glover, S., Glover, N. D., Kubanka	10
7.	Herbrandson, P., Caledonia, N. D., Black Don.	10
8.	Horton, A. A., Harlem, N. D., Velvet Don.	10
9.	Jacobsen, H., Kenmare, N. D., Velvet Don.	5
*10.	Klovstad, T. A. Davenport, N. D.	2
11.	Lee, Henry, Fingal, N. D., Yellow Gharnovka.	10
12.	Murrey, E. J., Lisbon, N. D., Kubanka	10

* Name of strain accidentally destroyed in station records.

		BUS.
13.	Ogard, R. A., Kenmare, N. D., Yellow Gharnovka	8
14.	Raedel, Rudolph, Glasston, N. D., Black Don	1
15.	Rasmussen, J. H., Kenmare, N. D., Yellow Gharnovka	8
16	Rognlie, O. P., Minnewaukan, N. D., Velvet Don	2
17.	Schollander, E. G., Montpelier, N. D., Kubanka	7
18.	Thoreson, Carl, Mayville, N. D., Kubanka	5
19.	Tweeten, J. T., Elisa, N. D., Black Don	5
	Total for 1902	125

MINNESOTA NO. 163 WHEAT, 1903.

		BUS.
1.	Duncan, Mrs. F. C., Fargo, N. D	70

KUBANKA DURUM OR MACARONI WHEAT, 1902.

		BUS.
1.	Ballard, H. S., McHenry, N. D	4
2.	Bates, A. C., Donnybrook, N. D	6
3.	Beltz, P. J., Buxton, N. D	10
4.	Bohnsack, J. D., Rock Lake, N. D	4
5.	Dakin, Bert, Page, N. D	10
6.	Hagen, Ole S., Crary, N. D	2
7.	Hebrandson, P., Caledonia, N. D	2
8.	Hendrickson, C., Grafton, N. D	5
9.	Hovd, G. O., Halstad, Minn	1
10.	Klindworth, Henry, Fessenden, N. D	10
11.	Laughlin, A. H., Lisbon, N. D	10
12.	McInnis, Murdoch, Edgeley, N. D	2
13.	Oliver, H. S., Lisbon, N. D	10
14.	Reynolds, H. F., Sterling, N. D	10
15.	Sprung, M. E., Lee, N. D	1
16.	Stevens, C. M., Clement, N. D	2
17.	Thoreson, Carl, Mayville, N. D	5
18.	Washburn, Geo. L., Montpelier, N. D	10.
	Total for 1902	110

DURUM OR MACARONI WHEAT, 1903.

		BUS.
1.	Carmeron, Peter, Tyner, N. D., Velvet Don	4
2.	Donnelly, Stephen, Nash, N. D., Kubanka	2
3.	Dussell, Chas., Williston, N. D., Velvet Don	10
4.	Green, L. B., Moose Jaw, Ass., Kubanka	30

		BUS.
5.	Noble, C. S., Knox, N. D., Velvet Don	4
6.	Ostreim, K. K., Leeds, N. D., Kubanka	3
7.	Schultz, Wm., Penn., N. D., Kubanka	1
8.	Smith Bros., Lawton, N. D., Velvet Don	2
9.	Sporeland, T., Gallatin, N. D., Kubanka	3
10.	Sutherland, W. R., Bismarck, N. D., Velvet Don	10
11.	Traynor, Thos., Island Lake, N. D., Kubanka	6
	Total for 1903	68

KUBANKA DURUM OR MACARONI WHEAT, 1904.

		BUS.
1.	Erickson, E. H., Leeds, N. D	3
2.	Hay, Wm. F., Knox, N. D	5
3.	Isaacson, John, White Earth, N. D	6
4.	Page, E. B., Leeds, N. D	5
5.	Paul, H. W., Michigan City, N. D	7
6.	Spalding, F. G., Leeds, N. D	5
7.	Stenquist, S. C., Larimore, N. D	25
8.	Swift, M., Leeds, N. D	5
9.	Weiner, John F., Mandan, N. D	4
	Total for 1904	65

NORTH DAKOTA NO. 100 CORN, 1901.

		QTS.
1.	Allin, R., Grafton, N. D	2
2.	Butler, E. C., Cooperstown, N. D	2
3.	Fjelstad, E. M., Forman, N. D	1
4.	Johnson, O. S., Dazey, N. D	2
5.	Kjelson, John, Dazey, N. D	1
6.	Moe, O. F., Finley, N. D	2
7.	Nygaard, C. H., DeLamere, N. D	1
8.	Olson, Fred, Sanborn, N. D	2
9.	Pierce, Dexter, Larimore, N. D	2
10.	Saurr, L. W., Fingal, N. D	2
11.	Scott, J. W., Gilby, N. D	2
12.	Smith, Harvey, Sibley Butte, N. D	2
13.	Todd, O. S., Ashtabula, N. D	2
14.	Todd, Oliver, Wilma, N. D	2
	Total for 1901	25

NORTH DAKOTA NO. 100 CORN, 1902.

		BUS.
1.	Grest, Nick, Leonard, N. D.	½
2.	Hebrtandson, P., Caledonia, N. D.	1
3.	Horton, A. A., Harlem, N. D.	1
4.	Jacobsen, Carl and Iver, Nome, N. D.	1
5.	Johnson, Martinnes, Nome, N. D.	½
6.	Kliner, Fred, Tower City, N. D.	½
7.	Larson, L. O., Dwight, N. D.	½
8.	Loebs, J. L., Aberdeen, S. D.	½
9.	McInnis, Murdoch, Edgeley, N. D.	1½
10.	Miller, Carl, Nome, N. D.	½
11.	Munter, L. B., Caledonia, N. D.	¼
12.	Nelson, Hagen, Nome, N. D.	½
13.	Page, Geo. C., Harvey, N. D.	½
14.	Peterson, John (Minn. King), Nome, N. D.	2
15.	Porter, Wm., Crystal, N. D.	¼
16.	Rand, Geo. E., Lisbon, N. D.	½
17.	Rysland, Sven, Grand Forks, N. D.	¼
18.	Sebby, Jacob, Fingal, N. D.	½
19.	Sejness, R. J., Fessenden, N. D.	½
20.	Stevens, C. M., Clement, N. D.	½
21.	Steven, Arne T., Veseleyville, N. D.	½
22.	Thorson, Martin, Fingal, N. D.	½
23.	Turnbull, W. J., Harwood, N. D.	½
	Total for 1902	16¾

GOLDEN DENT CORN, 1903.

		BUS.
1.	Anderson, John, Hillsboro, N. D.	½
2.	Bacon, J. D., Grand Forks, N. D.	1
3.	Beeber, R. F., Berlin, N. D.	½
4.	Berger, Chas., Leeds, N. D.	½
5.	Bestul, R. J., Grafton, N. D.	½
6.	Bowman, Erick, Edgeley, N. D.	½
7.	Dahlgren, Louis, Fargo, N. D.	½
8.	Davis, J. A., Buxton, N. D. (No. D. No. 100)	8
9.	Dodge, W. T., Buffalo, N. D.	½
10.	Dustrud, C. H., LaMoure, N. D.	½
11.	Enge, E. C. ,Milnor, N. D.	½
12.	Flewell Herbert, Wimbledon, N. D.	1
13.	Glarum, Ole, Newark, S. D.	½
14.	Grest, Nick, Leonard, N. D.	½
15.	Horton, A. A. Harlem, N. D.	1
16.	Kristjansen, Th., Edinburg, (N. W. Dent)	1

		BUS.
17.	Lanxon, Wm., Forman, N. D.	1
18.	Mattson, Ole, New Rockford, N. D.	½
19.	McCain, W. A., Blanchard, N. D.	½
20.	Meilicke, E. E., Wheatland, N. D.	2
21.	Myhre, M. G., Balfour, N. D.	¼
22.	Nesegard, K. A., Leeds, N. D.	2 lbs.
23.	Newton, Chas., Harwood, N. D.	1
24.	Olson, Peter, Hillsboro, N. D.	½
25.	Scheck, Hon. A., Washington, D. C.	2
26.	Suckow, W. R., Fargo, N. D.	8
27.	Wipperman, Max, Hankinson, N. D.	2
	Total for 1903	35.34p.

GOLDEN DENT CORN, 1904.

		BUS.
1.	Anderson, F. O., Sheyenne, N. D.	½
2.	Anderson, John, Hillsboro, N. D.	½
3.	Austin, O. A., McVille, N. D.	5 lbs.
4.	Barr, Wm., Algeo, N. D.	½
5.	Bradley, F. E., Sheyenne, N. D.	½
6.	Bush, A. K., Dover, Minn.	1 pk.
7.	Carlson, D., Underwood, N. D.	½
8.	Dodge & Co., C. A., Devils Lake, N. D.	½
9.	Evans, J. B., Agr. Col., Pullman, Washington	Small sample
10.	Fredrickson, H., Kindred, N. D.	½
11.	Grest, Nick, Leonard, N. D.	½
12.	Haberstad, J. H., Kindred, N. D.	½
13.	Halverson, H. P., Sheyenne, N. D.	½
14.	Hansen, J. P., Church's Ferry, N. D.	½
15.	Hans, Paul, Davenport, N. D.	1
16.	Hansen, F., Church's Ferry, N. D.	½
17.	Hertsgaard, A. P., Kindred, N. D.	½
18.	Hetler, J. F., Hillsboro, N. D.*	4
19.	Johnson, J. M., Kindred, N. D.	½
20.	Johnson, A. D., Sheyenne, N. D.	½
21.	Kirk Brothers, Niagara, N. D.	1½
22.	Kristjansen, Th. Gardar, N. D.	1
23.	Mattson, P. M., New Rockford, N. D.	½
24.	Munig, John, Devils Lake, N. D.	½
25.	Myhra, Nels G., Kindred, N. D.	½
26	Nettenn, G. J., Davenport, N. D.	½

* Supt. Hetler, of Traill county, distributed this strain of corn to about 400 school children to be grown in a prize corn contest.

		BUS.
27.	Olsness, S. A. ,Sheyenne, N. D.	½
28.	Owens, N. P., Dickinson, N. D.	½
29.	Phalen, O,. Crystal, N. D.	½
30.	Porter, John, Hoople, N. D.	½
31.	Peterson, P. S., Sheyenne, N. D.	½
32.	Richter, J. W., Sheyenne, N. D.	½
33.	Seastrund, E., Sheyenne, N. D.	½
34.	Sheppard, C. R., Judson, N. D.	1-3
35.	Smith, Henry L., Lakota, N. D.	1
36.	Soderholm, L. G., Sheyenne, N. D.	½
37.	Sollin, Thorwald, Rugby, N. D.	½
38.	Zickert, John, Church's Ferry, N. D.	½
	Total for 1904	22¾

NO. 39 POTATOES, 1902.

		BUS.
1.	Fatland, Even H., Walcott, N. D.	1
2.	Horton, A. A., Harlem, N. D.	1
3.	Larson, L. O., Dwight, N. D.	1
4.	Laughlin, A. H., Lisbon, N. D.	1
5.	Preston, C. W., Blanchard, N. D.	2
6.	Sprung, F. J., Ada, Minn.	1

NO. 47 POTATOES, 1902.

7.	Horton, A. A., Harlem, N. D.	1
8.	Jacobsen, H., Kenmare, N. D.	2
9.	Kristjansen, Th. T., Gardar, N. D.	2.
10.	Larson, L. O., Dwight, N. D.	1
11.	Laughlin, A. H., Lisbon, N. D.	1
12.	Pederson, Edward, Hatton, N. D.	2
13	C. W. Preston, Blanchard, N. D.	2
14.	Schollander, E. G., Montpelier, N. D.	2
15.	Sprung, F. J., Ada, Minn.	1
16.	Wills, Wilmot, Embden, N. D.	1

MISCELLANEOUS.

17.	Berger, O., Oakes, N. D., Rural New Yorker	1
18.	Fjelstad, E. M., Forman, N. D., Early Ades	1
	Total for 1902	24.

OATS, 1903.

		BUS.
1.	Bowman, Edward, Kenmare, N. D., Swedish Select	2½
2.	Macalpine, T., Vanderwort, S. D., Sixty Day	10
3.	Porter, Wm., Hoople, N. D., Swedish Select	2½
	Total for 1903	15

SIXTY DAY OATS, 1904.

		BUS.
1.	Anderson, Herbert, Wild Rice, N. D	10
2.	Bennett, F. C., Jamestown, N. D	4
3.	Convey, Thos., Ridgeway, Wis	5
4.	Nygard, K. S., Kellys, N. D	3
	Total for 1904	22

SWEDISH SELECT OATS, 1904.

		BUS.
1.	Bennett, F. C., Jamestown, N. D	4
2.	Herman, A. S., Argusville, N. D	2
3.	Manns, Thos., Montpelier, N. D	2
	Total for 1904	8

BARLEY, 1903.

		BUS.
1.	Duncan, Mrs. F. C., Fargo, Manscheuri	100
2.	Smith, J. W., Fargo, N. D	183
3.	Smith, J. W., Fargo, N. D., Common	17
	Total for 1903	300.

MANSCHEURI BARLEY, 1904.

		BUS.
1.	Manns, Thos., Montpelier, N. D	50
2.	Piper, Richard, Leonard, N. D	2
3.	Piper, R., Leonard, N. D	52
	Total for 1904	104

EMMER OR SPELT.

1.	Clark, W. W., Mountain View, Cal. (1901)	4 lbs.
2.	Stokes, H. B., Waterloo, Wis. (1900)	
3.	Wills, A. C., Cannon Ball, Sub. E. S. (1900)	
4.	Walters, L., Saric Sonora, Mex. (1904)	

CANADA FIELD PEAS, 1903.

	BUS.
1. Sohn, Geo., Haven, N. D.	2

SUMMARY.

Summary of seed distribution by North Dakota Experiment Station 1898 to 1904 inclusive:

Variety.	No. of Persons.	Bushels.
North Dakota No. 66 wheat	74	291.5
Minnesota 163 wheat	92	504.2
Macaroni wheat	71	393.0
Oats	10	45.0
Barley	6	401.0
Potatoes	18	24.0
Peas	1	2.0
North Dakota No. 100 corn	88	74.7
Golden dent	38	22.7
Emmer	4	.....
Total	402	1,593.5
Brome grass	363	*1,593.5
Slender wheat grass	5	*375
Total	368	1,968.5
Grains	402	1,593.5
Grasses	368	*140.6
Total	770	1,734.1

With so long a list and one covering so many years it is possible that errors, which frequently occur in overworked offices, may have crept in and that seed may have been furnished to a few persons not listed above. It will also doubtless be found that a number of deaths and removals will cause one to be unable to locate some of the persons at the addresses listed above.

That the list of names represents distributing agents for these improved seeds may be illustrated by the letters which appear below. These letters have been selected from the long list received to show that this improved seed dissemination has taken place in all of the grain producing parts of the state.

A. C. Bates, Donnybrook, N. D., writes the station as follows in the fall of 1904: "The Kubanka macaroni wheat received from the Experiment Station yielded as follows: Season of 1902, sixteen bushels per acre, grade No. 1; season of 1903, eighteen bushels per

* Calling fourteen pounds one bushel.

acre, grade No. 1; season of 1904, twenty-two bushels per acre, grade No. 1. * * * My crop is all sold or spoken for, for seed, and the local demand will require all of the seed in the market here * * *."

P. J. Beltz, Buxton, N. D., in the fall of 1904 writes as follows relative to the Kubanka seed wheat received from the Experiment Station: "Average yield for 1904, twenty-four bushels per acre. * * * We have about 3,000 bushels for sale. We have never shipped any of this wheat to the Duluh or Minneapolis markets, as we were unable to supply the local demand for seed. Sold some seed to our neighbors, and their return crop has already been sold to neighbors for $1 per bushel. Some of our macaroni wheat on corn ground went thirty-five bushels per acre this year. We will seed our entire crop to macaroni next year."

Nicholaus Grest, Leonard, N. D., in reporting upon five bushels of Minnesota 163 fife seed wheat received from the station in 1901 made the following statement: "My average yields have been as follows: Yield in 1901, fourteen bushels per acre; yield in 1902, twenty-nine bushels per acre; yield in 1903, twenty-two and one-third bushels per acre; yield in 1904, thirteen and one-quarter bushels per acre. Following is the list of names and addresses to whom I have sold the Minnesota 163 seed wheat and the quantity of it sent to each:

		BUS.
1.	Appel, John, Cannon, S. D.	10
2.	Andrews, Irving, Woods, N. D.	151
3.	Dittmer, C., Lynchburg, N. D.	62
4.	Hildebrandt, Wm., Davenport, N. D.	50
5.	Johnson, R. P., Gwinner, N. D.	9
6.	Meilicke, E., Wheatland, N. D.	81
7	Meilicke, E. E., Wheatland, N. D.	50
8.	Russ, Andrew, Woods, N. D.	50
9.	Salzwendea, Richard, Lynchburg, N. D.	30
10.	Schlener, F. E., Mantador, N. D.	2
11.	Schrink, Henry, Mandan, N. D.	8
12.	Unkenholz, S. W., Mandan, N. D.	6
13.	Wichmen, A. F., Leonard, N. D.	45
14.	Anderson, Apel, Larimore, N. D.	9
15.	Austin, O. A., McVille, N. D.	4½
16.	Burke, G. W., Surrey, N. D.	100
17.	Burris, Henry, Conway, N. D.	5
18.	Eggen, Thos., Madison, Wis.	125
19.	Evans, A. G., Mayville, N. D.	13
20.	Goggin, Wm., Fessenden, N. D.	8
21.	Gundvagen, M. S., Barton, N. D.	12
22.	Haus, Paul, Addison, N. D.	50
23.	Klindworth, Henry, Fessenden, N. D.	10

		BUS.
24.	Madison, Hans, Valley City, N. D.	28
25.	Missouri Valley Milling Co., Mandan, N. D.	5
26.	Oakley, F. B., Edgeley, N. D.	80
27.	Stenson, H., Starbuck, Minn.	135
28.	Bautz, Frank, Lynchburg, N. D.	85
29.	Dittmer, —., Lynchburg, N. D.	600

Total of 1,821½ bushels to twenty-nine persons."

Henry Jacobsen, Kenmare, N. D., gave the following report under date of December 14, 1904: "In the spring of 1904 I sold about 1,700 bushels of the seed of the Velvet Don strain of wheat secured originally from the Experiment Station. It was distributed as follows:

Oscar Will Seed Co., Bismarck, N. D., 100 bushels; farmers around Carpio, N. D., 400 bushels; farmers around Portal, N. D.; 45 bushels; farmers around Minot, N. D., 230 bushels; farmers around Balfour, N. D., 50 bushels; farmers around River Falls, Wis., 20 bushels; farmers in Kansas, Nebraska and Minnesota small amounts. The remainder all sold for seed around Kenmare. I have shipped twenty bushels of my 1904 crop to southern Idaho, * * *. I am holding 1,200 bushels for the spring trade."

J. L. Loebs, seedsman, Aberdeen, S. D., gives the following report on North Dakota No. 100 seed corn under date of December 10, 1904: "There are several things about this corn that I like which are as follows: It doesn't sucker and can therefore be planted very close. The stalks stand up straight and erect, ears will almost be ripe when stalk and leaves will yet hold their green. Stalks grow to medium height and ears well up from the ground, so it can be nicely cut with corn binder. I shall have only a very small amount of it for sale, perhaps not over twenty-five bushels. I have tested this and I find that every kernel brings a nice, strong sprout. I will send you a small sample of North Dakota No. 100 corn. I have already sold some of this corn to my neighbors."

H. G. Matteson, LaMoure, N. D., in a report written December 10, 1904, upon Minnesota 163 fife seed wheat received from the Experiment Station in 1901, says: "Sold all I raised in 1902 and 1903 to my neighbors. * * * *I have 1,000 bushels of it on hand."

Edward Pederson, Hatton, N. D., under date of December 8, 1904, writes the following relative to the seed of Minnesota 163 wheat and North Dakota No. 47 potatoes received from the Experiment Station, both of which were sent him in 1902: "* * * The wheat yielded about nineteen one half bushels this year, twenty bushels in 1903 and twenty-six bushels per acre in 1902. I think my 1904 crop will grade 1 Northern. I have sold no Minnesota 163 wheat except for seed. * * * I have about 1,400 bushels of it on hand which I expect to sell for seed. My North Dakota No. 47 potatoes which

I secured from the station yielded 200 bushels per acre in 1903 and 240 bushels per acre in 1904. They are large and very fine eating potatoes and they are good keepers, although they are not as good keepers as the Snowflakes. * * * I sold some for seed last year and they are well pleased with them. I have sold some for seed again this year and can spare twenty-five bushels more which I expect to sell for seed this spring."

Lewis Pond of Church's Ferry, N. D., gives the following report upon Minnesota 163 seed wheat grown from seed secured from this station: * * * "List of buyers of Minnesota 163 wheat and number of bushels taken by each:

	BUS.
Anton Blegen, Church's Ferry, N. D.	20
Hans O. Blegen, Church's Ferry, N. D.	12
Ole Froholm, Church's Ferry, N. D.	7
John Lunde, Church's Ferry, N. D.	12
John Vamburg, Church's Ferry, N. D.	5
Lars Foss, Church's Ferry, N. D.	12
Bent Muri, Church's Ferry, N. D.	4¾
Geo. McDonell, Church's Ferry, N. D.	7
John Martin, Church's Ferry, N. D.	5
Rasmus Yre, Church's Ferry, N. D.	5
Shellenberger & Peterson, Minnewaukan, N. D.	27
Wm. Keister, Berwick, N. D.	10
C. A. Stubbins, Granville, N. D.	15
Frank Fox, Granville, N. D.	10
Anton Sto., Penn, N. D.	10
Albert Jaster, Penn, N. D.	5¼
John Doyle, Penn, N. D.	2
Elmer Carlson, Surrey, N. D.	5
Nick Ludowese, Sheldon, Iowa	10

Smith Brothers of Lawton, N. D., in a report sent to the station in the fall of 1904, state that they have 1,000 bushels of Velvet Don durum or macaroni seed wheat which weighs sixty-four pounds per bushel. Their wheat is descended from Velvet Don durum or macaroni seed sent to them by the Experiment Station.

J. T. Tweeten, of Elisa, N. D., in a report bearing the date of December 11, 1904, upon Black Don durum or macaroni seed wheat secured from the station says: "In 1902 I got five bushels of Black Don macaroni wheat from which I threshed 237 bushels, which weighed sixty-five pounds to the bushel. In 1903 the macaroni went eighteen bushels * * * and in 1904, twenty-two bushels per acre. I have about 2,000 bushels left, but have sale for most of it here. I will mail you herewith a sample. * * * Those who bought seed from me and who have some left are E. A. Froiseth and Lee Price of Fisher, Rolette county, Victor Busby, Dunseith and Linnius Johnson, Pleasant Lake, N. D."

John Young of Berlin in a recent report upon Minnesota 163 seed wheat received from the Experiment Station in 1901 writes: * * * "Last year I sold Gust Lepard fifty bushels, John Kercher 200 bushels and August Shockman fifty bushels."

With individual farmers reporting having sold thousands of bushels of seed wheat to their neighbors from the increase secured from a five or ten bushel shipment sent out by the Experiment Station, it scarcely seems necessary to comment especially upon the value of the work of seed breeding and distribution to the state, and it certainly indicates that the station has found a successful method of seed dissemination.

RED CLOVER TRIALS.

In a co-operative trial with the bureau of plant industry, red clover seed from different states and countries is being given a further trial upon the station grounds. Twenty samples from the following sources constitute the seed which is being compared:

1. Western bulked clover seed.
2. Western Ohio clover seed.
3. North Indiana clover seed.
4. South Indiana clover seed.
5. Illinois clover seed.
6. Missouri clover seed.
7. Iowa clover seed.
8. Western bulked No. 1 clover seed.
9. Western bulked No. 2 clover seed.
10. Michigan clover seed.
11. Nebraska clover seed.
12. Eastern Ohio clover seed.
13. Kentucky clover seed.
14. Tennessee clover seed.
15. Russian No. 1 clover seed.
16. Russian No. 2 clover seed.
17. Russian No. 3 clover seed.
18. Russian No. 4 clover seed.
19. Wisconsin clover seed.
20. Oregon clover seed.

The land used for this trial produced a crop of corn in 1902, barley in 1903 and the clover trial plats were seeded with wheat as a nurse crop in 1904. The field had been fall plowed in 1903. It was disced on May 10th and harrowed twice with a peg tooth harrow on May 11th. The land was very wet in the spring and after the excess of water finally evaporated a period of very dry weather caused the soil to bake. The seed bed was far from being in an ideal condition on May 12th, the date upon which the wheat was seeded. The wheat was sown at the rate of five pecks per acre with fife seed. Four days later the clover seed was sown by hand at a rate slightly

less than ten pounds per acre. The clover seed was covered by harrowing with a peg tooth harrow.

Notes recorded on June 15th state that the wheat was showing a good stand and that the clover plants had appeared above the surface. On the above date it was observed that the clover was showing especially well upon the higher places in the almost level field.

On the dates July 25th and 26th, the wheat, which was just forming kernels, was cut for hay and removed from the field. The sickle bar was set as high as the machine would allow and left the stubble about five inches high. The best of the clover was so high upon that date that it was clipped off by the sickle.

On August 2d, Missouri (No. 6), Eastern Ohio (No. 12), Russian (No. 15) and Wisconsin (No. 19) made a much better showing than the plats from other sources of seed. Observations recorded on September 10th show especially favorable to Missouri (No. 6) and Wisconsin (N. 19), while Illinois (No. 5) and Russian (No. 15) were reported as showing well.

On the above date which was immediately followed by a killing frost, there seemed to be a sufficient growth of clover plants and of wheat stubble to form a moderate winter protection.

VARIETIES OF WHEAT.

Fifty-seven varieties of wheat were sown on May 11 and 12, 1904, at a depth of one and a half to two inches. The fife and blue stem strains were seeded at the rate of six pecks and the macaroni strains at the rate of eight pecks, treated seed, per acre. The wheat was sown on ground which produced corn the previous year. The trial plats consisted of one-tenth acre for each variety. Eighteen-inch alley ways were left between the different plats. The ground had been fall plowed and by double or cross discing and harrowing with a peg tooth harrow, it was put in good condition for seeding. The soil was a little too wet below the surface but the surface was in good condition when the wheat was seeded. The seed was put in with a Monitor double disc drill with its fast feed in operation. On May 21st the varieties of wheat were coming up and on June 15th all of the varieties had a good, thrifty start, and no difference could be detected in their vigor. The table furnished herewith gives a record of the facts obtained in the trial:

TABLE NO. I.—VARIETIES OF

Bulletin No.	Accession Number	Variety	Class	Where From
197	210	Preston	Fife	Prof. Wm. Saunders, Toronto
250	782	Sel. Glyndon (818)—Minn. 155	Fife	Minn. Experiment Station
260	797	Select Minnesota 293	Fife	Minn. Experiment Station
261	920	Experiment Station 66	Fife	North Dakota Exp. Station
254	846	Pillsbury	Fife	Northrup, King & Co.
253	845	Saskatchewan	Fife	Northrup, King & Co.
258	795	Selected Minnesota 288	Fife	Minn. Experiment Station
257	794	Selected Minnesota 285	Fife	Minn. Experiment Station
286	1105	Wilcox	Fife	W. W. Kempton, North Dakota
236	419	Wellman's	Fife	Exp. Farm, Brandon, Man.
288	317	North Dakota—crossbred	Fife	North Dakota Exp. Station
290	322	North Dakota—crossbred	Fife	North Dakota Exp. Station
291	323	North Dakota—crossbred	Fife	North Dakota Exp. Station
252	785	Select McKendry's—Minn. 181	Fife	Minn Experiment Station
151	201	Glyndon 711	Fife	Minn. Experiment Station
292	646	Canada	Fife	Geo. Springfield, Crystal, N. D.
293	711	Sel. Rystings—Minnesota 171	Fife	Minn. Experiment Station
294	312	Selected Powers	Fife	North Dakota Exp. Station
295	313	Selected Powers	Fife	North Dakota Exp. Station
296	314	Selected Glyndon (811)	Fife	Minn. Experiment Station
297	315	Selected Glyndon (753)	Fife	Minn. Experiment Station
289	319	North Dakota—crossbred	Fife	North Dakota Exp. Station
	1437	Minnesota 63	Fife	Ole Hoff, North Dakota
298	320	North Dakota—crossbred	Blue Stem	North Dakota Exp. Station
299	321	North Dakota—crossbred	Blue Stem	North Dakota Exp. Station
262	718	Haynes' Pedigreed	Blue Stem	L. H. Haynes, Fargo, N. D.
263	722	Marvel	Blue Stem	J. A. Salzer Seed Co.
264	779	Haynes' Minnsota 51	Blue Stem	Minn. Experiment Station
265	780	Bolton's Minnesota 148	Blue Stem	Minn. Experiment Station
267	872	American	Blue Stem	Wm. Rennie, Toronto, Can.
300	318	North Dakota—crossbred	Blue Stem	North Dakota Exp. Station
287	316	Selected Haynes	Blue Stem	North Dakota Exp. Station
301	1161	Davis	Blue Stem	J. A. Davis, Barton, N. D.
	709	North Dakota—crossbred	Fife	North Dakota Exp. Station
	710	North Dakota—crossbred	Blue Stem	North Dakota Exp. Station
	1158	Ten Eycks	Fife	North Dakota Exp. Station
	1438	Blue Stem	Blue Stem	Ole Hoff, N. D.
	1442	Russel's Prolific	Fife	Bottineau, N. D., by W. Russel
	627	Romonow	Fife	Sitka, Alaska
276	913	Medeah U. S. 1371	Macaroni	Algiers by U. S. Dept. of Agr.
277	914	Yellow Gharnovka 1444	Macaroni	Ambroceivka, Rus., U. S. Dep. Ag.
279	916	Black Don U. S. 1446	Macaroni	Ambroceivka, Rus., U. S. Dep. Ag.
273	910	Argentine	Macaroni	Marseilles, France, U. S. Dep. Ag.
280	917	Gharnovka U. S. 1447	Macaroni	Tagenrog, Rus., U. S. Dept. Agr.
282	929	Kubanka U. S. 1440	Macaroni	Russia, by U. S. Dept. Agr.
283	930	Velvet Don U. S. 1445	Macaroni	Ambroceivka, Rus., U. S. Dep. Ag.
270	907	Berdianska U. S. 1586	Macaroni	Russia, by U. S. Dept. Agr.
271	908	Novorossick U. S. 1567	Macaroni	Russia, by U. S. Dept. Agr.
274	911	Tagenrog U. S. 1570	Macaroni	Russia, by U. S. Dept. Agr.
281	919	Belotourka U. S. 1520	Macaroni	Russia, by U. S. Dept. Agr.
302	543	Nicaragua U. S. 4277	Macaroni	U. S. Department Agriculture
223	329	Kubanka U. S. 2953	Macaroni	Russia, by U. S. Dept. Agr.
222	328	Pererodka U. S. 2954	Macaroni	Russia, by U. S. Dept. Agr.
278	915	Gharnovka U. S. 1443	Macaroni	Russia, by U. S. Dept. Agr.
	1157	Selected Pererodka	Macaroni	North Dakota Exp. Station
268	778	Aranautka	Macaroni	T. N. Oium, Lisbon, N. D.
269	873	Wild Goose	Macaroni	Wm. Rennie, Toronto, Canada

The accession numbers are field numbers, the bulletin numbers are the ones under which they have been previously published.

WHEAT—CROP OF 1904.

Days Maturing	Length of Stem—In.	Length of Head—In.	Bearded, Smooth or Velvety	Rust—Per Cent	Weight Per Bu.—Lbs.	Grades	Yield Per Acre—Bu.	Aver. for 1903-1904
100	30	3	Bearded	100	44	Rej	7.1	22.9
105	36	3½	Smooth	100	52	No. 4	15.4	26.6
105	36	3¼	Smooth	100	53	No. 4	16.2	27.2
104	36	3	Smooth	100	54	No. 4	15.2	26.8
104	36	3½	Smooth	100	51	No. 4	13.8	25.4
104	36	3½	Smooth	100	52	No. 4	14.7	24.5
105	36	3¼	Smooth	100	51	No. 4	15.2	28.0
104	36	3¼	Smooth	100	53	No. 4	16.4	28.8
105	36	3¼	Smooth	100	49	Rej	14.2	26.5
105	36	3¼	Smooth	100	49	No. 4	13.2	27.7
105	34	2¾	Smooth	100	52	No. 4	14.7	28.1
105	34	2¾	Smooth	100	50	Rej	10.4	27.4
105	34	2¾	Smooth	100	50	No. 4	16.2	26.3
104	32	3	Smooth	95	49	No. 4	11.4	27.9
105	36	3	Smooth	100	51	No. 4	13.4	28.3
105	36	3	Smooth	100	53	No. 4	14.2	25.9
104	36	3¼	Smooth	100	51	No. 4	15.0	28.6
105	36	3	Smooth	100	52	No. 4	14.7	28.1
105	32	2½	Smooth	100	52	Rej	13.4	27.7
105	34	3	Smooth	100	..	.....	*	
105	34	3	Smooth	100	..	.....	*	
105	36	3¼	Smooth	100	54	No. 4	16.2	24.3
105	34	3	Smooth	100	53	No. 4	15.4	
106	38	3¾	Velvety	100	53	No. 4	17.3	26.0
105	36	3	Velvety	100	51	Rej	7.6	21.7
106	38	3½	Velvety	100	53	No. 4	16.2	26.4
106	38	3½	Velvety	95	54	No. 4	16.2	26.9
104	38	3¾	Velvety	100	53	No. 4	15.2	27.2
104	36	3½	Velvety	100	53	No. 4	15.0	29.1
106	36	3¼	Velvety	100	54	No. 4	16 9	28.5
106	38	3½	Velvety	100	54	No. 4	16.2	27.6
106	38	3½	Velvety	100	54	No. 4	16.4	31.8
106	38	3¾	Velvety	100	52	No. 4	17.3	28.5
104	36	3¼	Smooth	100	53	No. 4	16.4	20.1
106	38	5¾	Velvety	95	52	No. 4	17.1	26.5
105	32	3½	Bearded	100	53	Rej	14.7	
105	36	3½	Velvety	90	54	No. 3	15.4	
105	34	3½	Bearded	100	43	Rej	6.9	
98	30	2	Sm. Bearded	100	49	Rej	10.4	21.5
105	32	2	Sm. Bearded	10	59	No. 2	19.0	27.8
105	30	2	Sm. Bearded	10	61.5	No. 1	24.7	33.2
105	32	2¼	Vel. Bearded	10	61.5	No. 2	25.9	35.6
105	32	2	Sm. Bearded	5	63	No. 2	24.0	34.3
105	34	2	Sm. Bearded	5	62.5	No. 2	23.6	35.0
105	34	2	Sm. Bearded	8	62	No. 3	21.9	32.9
105	32	2	Vel. Bearded	10	63	No. 2	18.5	30.5
105	28	2	Sm. Bearded	10	61	No. 3	15.7	28.0
105	28	2	Sm. Bearded	10	61	No. 2	15.5	33.5
105	28	2	Sm. Bearded	10	61	No. 2	18.5	32.6
105	34	2¼	Sm. Bearded	5	61	No. 3	17.8	32.1
105	28	2½	Sm Bearded	15	59	No. 3	15 1	31.9
105	32	2¼	Sm. Bearded	5	60.5	No. 2	17.6	34.0
105	32	2	Sm. Bearded	8	62.5	No 2	17.8	32.4
105	32	2¼	Sm. Bearded	5	62.5	No. 3	20.8	32.7
105	34	2¼	Sm. Bearded	5	61	No. 2	20 8	
106	32	2¼	Sm. Bearded	5	63.5	No. 2	20.5	31.9
10 6	3_{38}	2¼	Sm. Bearded	5	64	No. 3	20.4	32.2

* Weights lost in threshing.

The yields and grades of wheat produced in 1904 rank far below the average for past seasons, due to the severe attack of rust. No difference in hardiness or rust resistance could be detected between the fife and blue stem classes, but the durum or macaroni strains showed qualities very much superior to either in this respect. A few of the durum varieties rusted in the head badly. The durum or macaroni varieties suffered from the wet condition of the soil in the spring, the excess of water having reduced the stand somewhat. All of the varieties suffered from the dry spell of weather which occurred later in the season. The thickest and rankest growing wheat rusted much worse than the thin grain, so the plats that had the best appearance early in the season gave the poorest returns. The effect of the thickness and rankness of the stand upon its degree of rust resistance was clearly demonstrated in the rotation trial plats where a single strain of wheat was used for seed and the plats received different treatment. In every instance the rank growths were much more severely attacked by the rust. In the variety trial this factor could not be determined. In nearly every case the strains which had been selected in the nursery, *i. e.*, those which had a strong line of breeding behind them, gave the larger yields and as good or better grades.

Summarizing the results from the different classes of wheat recorded for 1904 and taking the average of the best six varieties of fife, blue stem and macaroni, the following tables result:

TABLE II.—VARIETIES OF WHEAT IN EACH CLASS GIVING LARGEST YIELDS IN 1904

Bulletin No.	Accession No.	Variety	Class	Grade	Weight Per Bu. Pounds	Yield Per Acre. Bushels
	709	North Dakota crossbred	Fife	No. 4	53	16.4
257	794	Selected Minn. No. 285	Fife	No. 4	53	16.4
291	323	North Dakota crossbred	Fife	No. 4	50	16.2
289	319	North Dakota crossbred	Fife	No. 4	54	16.2
250	782	Selected Glyndon (818) Minn. 155	Fife	No. 4	52	15.4
280	797	Selected Minn. 293	Fife	No. 4	52	15.4
298	320	North Dakota crossbred	Blue Stem.	Rej. 1	53	17.3
301	1161	Davis'	Blue Stem.	No. 4	52	17.3
267	872	American	Blue Stem.	No. 4	54	16.9
	710	North Dakota crossbred	Blue Stem.	No. 4	52	17.1
287	316	Selected Haynes'	Blue Stem.	No. 4	54	16.4
	709	North Dakota crossbred	Blue Stem.	No. 4	53	16.4
279	916	Black Don U. S. No. 1446	Macaroni.	No 2	61.5	25.9
277	914	Yellow Gharnovka U. S No. 1444	Macaroni.	No. 1	61.5	24.7
273	910	Argentine	Macaroni.	No. 2	63	24.0
280	917	Gharnovka U. S. No. 1447	Macaroni.	No. 2	62.5	23.6
282	929	Kubanka U. S No. 1445	Macaroni.	No. 3	62	21.9
278	915	Gharnovka U. S. No. 1443	Macaroni.	No. 3	62.5	20.8

TABLE III.—COMPARING THE AVERAGE YIELD OF THE BEST SIX VARIETIES OF WHEAT IN EACH CLASS FOR 1904

Class	Average Yield Per Acre—Bu.	Difference—Bu.
Durum or macaroni	23.5	
Fife	16.0	7.5
Blue stem	16.9	6.6
Blue stem and fife	16.4	7.1

By referring to table II it will be seen that eleven out of the twelve varieties giving the largest yields were those which come from the plant breeding nurseries of either the North Dakota or Minnesota Experiment Stations. The one exception was a blue stem which was originally obtained from L. H. Haynes, a grain grower, who had done careful seed breeding with this strain of wheat for about twenty years, basing his selection upon the individual plant basis. It will also be noted, in comparing the average yields of the best six varieties of each class, that the blue stem out-yielded the fife nine-tenths of a bushel per acre, while the durum or macaroni strains gave 7.5 bushels per acre more grain than the fife and 7.1 bushels more than the average of the fife and blue stem. It should be remembered in this connection that the durum or macaroni wheat suffered much less from the rust than the other strains, but the wet condition of the soil when the plants were young gave the durum or macaroni varieties a severe test, as they withstand dry more naturally than wet conditions.

The following table gives the comparative yields of fife and blue stem with durum or macaroni wheat for six years, 1899 to 1904 inclusive:

TABLE IV.—COMPARING THE AVERAGE YIELD OF THE BEST THREE VARIETIES OF MACARONI WHEAT WITH FIFE AND BLUE STEM FOR SIX YEARS.

Year	Macaroni—Bushels	Fife and Blue Stem—Bushels	Difference—Bushels
1899	34.9	26.6	+8.3
1900	20.5	23.6	−3.1
1901	33.1	28.6	+4.5
1902	32.6	24.9	+7.7
1903	47.5	43.8	+3.7
1904	24.8	16.8	+8.06
Average for six years	32.2	27.4	+4.85

With the exception of one year, the durum or macaroni strains have given the larger yields, while the average for six years gives the durum or macaroni strain an advantage of 4.85 bushels per acre. With the average results for six consecutive years showing a yield of nearly five bushels per acre in favor of durum or macaroni wheat as compared with the fife and blue stem strains on the station grounds, it seems safe to say that an increase in returns from 15 to 20 per cent in favor of durum wheat may be confidently expected under Red river valley conditions, while a much larger advantage in its favor will obtain further west in the state.

The following table summarizes the list of the varieties of wheat in each class which have given the largest average yield for 1903 and 1904:

TABLE V.—VARIETIES OF WHEAT IN EACH CLASS GIVING THE LARGEST AVERAGE YIELDS IN 1903 AND 1904

Bulletin No.	Accession No.	Variety	Class	Grade		Weight Per Bu.—Lbs.		Average Yield—Bushels
				1903	1904	1903	1904	
257	794	Select Minn. 285	Fife	1H	No. 4	61½	53	28.8
293	711	Select Rystings Minn. 171	Fife	1N	No. 4	57½	51	28.6
151	201	Glyndon 711	Fife	1N	No. 4	58½	51	28.3
294	312	Select Powers	Fife	1H	No. 4	57½	52	28.1
288	317	North Dakota crossbred	Fife	1H	No. 4	60¾	52	28.1
265	780	Bolton's Minn. 146	Blue stem	1N	No. 4	60	53	29.1
267	872	American	Blue stem	1N	No. 4	60	54	28.5
301	1161	Davis	Blue stem	1N	No. 4	59¼	52	28.5
300	318	North Dakota crossbred	Blue stem	1N	No. 4	60½	54	27.6
287	316	Select Haynes	Blue stem	1N	No. 4	56½	54	31.8
279	916	Black Don U. S. 1446	Macaroni	No. 1	No. 2	62½	61½	35.6
280	917	Gharnovka U. S. 1447	Macaroni	No. 1	No. 2	62½	62½	35
271	908	Navorsisk U. S. 1567	Macaroni	No. 2	No. 2	62	61	33.5
223	329	Kubanka U. S. 2953	Macaroni	No. 1	No. 2	62¾	60½	34
273	910	Argentine	Macaroni	No. 1	No. 2	63	63	34.3

For the fife and blue stem strains it will again be noted that those which came from the plant breeding nurseries have given the largest yields. No durum or macaroni strains have as yet been long enough in the possession of the Experiment Station to receive the careful selection that the fifes and blue stems have had, but in a few years there is good reason to believe that the nursery bred durum or macaroni varieties will show the same general stimulated results in yield and grade as their sister varieties have obtained. The greater the number of years which may be summarized in a table the more important is the evidence which that table bears. Table VI summarizes the results obtained from the best five strains in each class for the past three seasons:

TABLE VI.—VARIETIES OF WHEAT IN EACH CLASS GIVING THE LARGEST AVERAGE YIELDS IN THREE YEARS

Bulletin No.	Accession No.	Variety	Class	Grade			Weight Per Bushel —Pounds			Average Yield Per Acre
				1902	1903	1904	1902	1903	1904	
293	711	Rysting's fife 171	Fife	1N	1N	No. 4	60	57 1/4	51	28.1
257	794	Select Minn. 285	Fife	1N	1H	No. 4	60 1/2	61 1/2	53	27.7
296	314	Select Glyndon	Fife	1N	1H	.....	58 1/2	59	...	29.8
289	318	North Dakota crossbred	Fife	2N	1N	No. 4	59 1/2	56 1/2	54	29.2
295	313	Select Powers	Fife	1N	1N	Rej.	61 1/2	60 1/2	52	29.1
300	318	Crossbred Glyndon	Blue Stem	2N	1N	No. 4	59 3/4	60 1/2	54	27.1
	710	Select Haynes' Minn. 169	Blue Stem	2N	2N	No. 4	58 1/2	56	52	26.6
263	722	Marvel	Blue Stem	1N	1N	No. 4	58 1/2	60	54	26.0
298	320	Crossbred Haynes' blue stem	Blue Stem	2N	1N	No. 4	59 3/4	59 3/4	53	25.4
287	316	Selected Haynes	Blue Stem	2N	1N	No. 4	57 1/4	60	53	25.3
279	916	Black Don	Macaroni	.....	No. 1	No. 2	63	62 1/4	61.5	34.5
280	917	Gharnovka	Macaroni	No. 1	No. 1	No. 2	63 1/2	62 1/4	62.5	33.4
277	914	Yellow Gharnovka	Macaroni	No. 2	No. 1	No. 1	63	62 1/2	61.5	33.1
273	910	Argentine	Macaroni	No. 2	No. 1	No. 2	63 3/4	63	63.0	32.7
274	911	Taganrog	Macaroni	No. 2	No. 1	No. 2	63 1/4	62 3/4	61.0	32.3

Attention should be again called to the fact that the strains from the plant nursery, with but a single exception, gave the largest average yields for three years. The power of the strains which have received careful, rigid selection and breeding to repeatedly give the largest yields constitutes a strong recommendation of careful seed selection. More new strains from outside sources are eagerly sought and all of the promising ones heard of are added to the test every year, but hardly a single one approaches the best of those already in the trial.

As a means of presenting the data secured, a detailed yearly report giving the yields obtained for the varieties which have been in the test three years or more is presented in the following table:

TABLE VII.—VARIETIES OF WHEAT, GIVING YIELDS FOR YEARS GROWN

Bulletin No.	Accession No.	Variety	Yield Per Acre—Bushels												Average
			1892	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	
261 (61) *	920	Experiment station No. 66	21.3	15.1	12.7	41.2	19.7	10.7	34.6	24.7	18.8	27.0	23.1	38.5	15.2	23.2
236 (50) *	419	Wellman's fife	23.0	12.2	....	42.0	....	11.6	34.3	24.3	27.9	27.9	21.3	42.3	13.2	25.4
265 (146) *	780	Bolton's bluestem	....	17.8	12.3	42.0	....	10.0	36.4	26.6	25.6	29.7	17.5	43.2	15.0	25.1
151	201	Glyndon (711)	....	....	....	....	....	8.5	35.6	24.8	25.5	....	24.0	43.4	13.4	25.0
197	210	Crossbred Preston	....	....	....	....	....	11.8	37.9	27.6	10.4	24.9	25.0	38.7	7.1	22.9
293 (215) *	711	Rystings' fife Minn. 171	....	....	....	....	....	....	38.1	26.6	20.0	....	27.1	42.3	15.0	28.2
252 (216) **	785	Select McKendry's fife	....	....	....	....	....	....	35.5	24.5	21.7	27.1	24.0	44.5	11.4	26.9
250 (210) **	782	Select Glyndon (818)	....	....	....	....	....	....	....	23.6	20.7	25.3	24.1	37.8	15.4	24.9
253	845	Saskatchewan fife	....	....	....	....	....	....	....	....	....	27.2	24.1	34.3	14.7	25.0
257	794	Select Minn. 285	....	....	....	....	....	....	....	....	....	29.9	25.3	41.3	16.4	28.2
258	795	Select Minn. 288	....	....	....	....	....	....	....	....	....	24.9	25.8	40.8	15.2	26.7
262	718	Haynes' Pedigreed B. S	....	....	....	....	....	....	....	....	....	28.1	21.2	36.7	16.2	25.5
263	722	Marvel	....	....	....	....	....	....	....	....	....	28.7	24.1	37.7	16.2	26.7
264	779	Haynes' Minn. 51	....	....	....	....	....	....	....	....	....	29.7	21.2	39.3	15.2	26.3
267	872	American Blue Stem	....	....	....	....	....	....	....	....	....	30.5	18.1	40.1	16.9	24.6
260	797	Minn. No. 260	....	....	....	....	....	....	....	....	....	25.6	23.4	38.2	16.2	25.8
286	1105	Wilcox fife	....	....	....	....	....	....	....	....	....	....	22.8	38.9	14.2	25.3
292	646	Canadian fife	....	....	....	....	....	....	....	....	....	....	27.1	37.7	14.2	26.3
294	312	Select Powers' fife	....	....	....	....	....	....	....	....	20.2	....	26.0	41.5	14.7	25.6
296	314	Select Glyndon	....	....	....	....	....	....	....	....	21.9	....	26.0	41.6	....	29.8
297	315	Select Glyndon	....	....	....	....	....	....	....	....	18.9	....	26.7	29.2	....	24.9
287	316	Select Haynes' B. S	....	....	....	....	....	....	....	....	20.9	....	23.8	47.3	16.4	27.1
288	317	Crossbred Powers' fife	....	....	....	....	....	....	....	....	20.8	....	21.6	41.6	14.7	24.7
300	318	Crossbred Glyndon	....	....	....	....	....	....	....	....	16.3	....	26.2	39.1	16.2	24.4
289	319	Crossbred	....	....	....	....	....	....	....	....	16.4	....	27.8	32.4	16.2	23.2
298	320	Crossbred Haynes' B. S	....	....	....	....	....	....	....	....	17.2	....	24.3	34.8	17.3	23.4
299	321	Crossbred Haynes' B. S	....	....	....	....	....	....	....	....	17.1	....	23.9	35.8	7.6	21.1
290	322	Crossbred	....	....	....	....	....	....	....	....	14.3	....	25.4	44.4	10.4	23.6
291	323	Crossbred	....	....	....	....	....	....	....	....	16.3	....	23.0	34.5	16.2	22.5
295	313	Select Powers' fife	....	....	....	....	....	....	....	....	36.4	....	31.9	42.0	13.4	31.2
	709	Select Glyndon Minn. 163	....	....	....	....	....	....	....	....	....	....	29.1	23.9	11.4	23.1
	710	Select Haynes' B. S. Minn. 169	....	....	....	....	....	....	....	....	....	....	26.9	35.9	17.1	26.6
	627	Romonow	....	....	....	....	....	....	....	....	....	....	23.6	32.7	10.4	22.2
222	328	Pererodka Macaroni	....	....	....	....	....	....	....	38.4	17.1	34.7	25.7	47.0	17.8	29.5
223	329	Kubanka Macaroni	....	....	....	....	....	....	....	30.0	....	32.4	28.7	44.0	17.6	30.5
274	911	Tagenrog Macaroni	....	....	....	....	....	....	....	....	....	29.7	31.7	46.7	18.5	31.6
280	917	Gharnovka Macaroni	....	....	....	....	....	....	....	....	....	32.4	30.3	46.5	23.6	33.2
283	930	Velvet Don Macaroni	....	....	....	....	....	....	....	....	....	29.6	32.5	42.6	18.5	30.8
281	919	Belotourka Macaroni	....	....	....	....	....	....	....	....	....	32.6	29.9	46.3	17.8	31.6

269	873	Wild Goose Macaroni	....	....	....	....	....	....	....	....	....	33.1	26.3	44.0	20.4	30.9
270	907	Berdiansk Macaroni	....	....	....	....	....	....	....	....	....	29.5	28.7	40.6	15.7	28.6
271	968	Novorossisk Macaroni	....	....	....	....	....	....	....	....	....	33.4	20.6	41.5	15.5	27.7
273	910	Argentine	....	....	....	....	....	....	....	....	....	28.4	29.5	44.6	24.0	31.6
276	913	Mediah	....	....	....	....	....	....	....	....	....	24.9	29.4	36.6	19.0	27.5
279	916	Black Don Macaroni	....	....	....	....	....	....	....	....	....	25.9	32.3	45.4	25.9	32.4
277	914	Yellow Gharnovka Macaroni	....	....	....	....	....	....	....	....	....	30.8	33.0	41.7	24.7	32.5
282	929	Kubanka Macaroni	....	....	....	....	....	....	....	....	....	32.4	28.7	44.0	21.9	31.7
302	543	Nicaragua	....	....	....	....	....	....	....	....	20.4	....	26.5	48.7	15.1	27.7
278	915	Gharnovka Macaroni	....	....	....	....	....	....	....	....	....	31.4	25.8	44.5	20.8	30.6
268	778	Aronautka Macaroni	....	....	....	....	....	....	....	....	20.6	34.0	28.7	43.4	20.5	29.4

* Selection made in 1901 from original seed.
** Seed renewed from other stations in 1901, originally from N. D. station.
Numbers in parenthesis are numbers under which original seed was published.

VARIETIES OF WINTER WHEAT.

Four varieties of winter wheat were planted in the fall of 1903. Two came from Russia, one from Northrup, King & Co., and one was from seed which was produced on the station trial grounds the previous year. The plants started nicely, but killed out completely during the winter. The records of the tests of winter wheat show a series of failures to withstand the severe winters.

FERTILIZER TEST WITH WHEAT.

Table VIII presents the facts obtained in the trial:

TABLE VIII.—FERTILIZER EXPERIMENTS WITH WHEAT—CROP OF 1904

Plot No.	Name of Fertilizer	Amount of Fertilizer Per Acre	Lodged—Per Cent	Per Cent Rust	Grade	Weight Per Bu. —Pounds	Yield Per Acre—Bushels
1	No fertilizer		0	70	Rej..	53	11.7
2	Rotted manure	10 loads	0	70	Rej..	53	11.3
3	Aciduated bone meal	200 pounds	0	70	Rej..	52½	11.5
4	Armour's Grain Grower	200 pounds	0	70	Rej..	52	10.0
5	Phosphate and potash fertilizer	200 pounds	0	70	Rej..	53	11.2
6	Cereal phosphate	200 pounds	0	70	Rej..	52½	10.0
7	Slacked lime	250 pounds	0	70	Rej..	52½	10.6
8	Nitrate of soda	150 pounds	0	70	Rej..	53	10.5
9	{ Armour's Grain Grower { Nitrate of soda	150 pounds 100 pounds	0 0	70	Rej..	53	11.7

The best gave no positive results, as the effects of the rust attack made no conclusion possible. The wheat rusted so badly that it failed to grade better than rejected in any case.

PREPARATION OF CORN STUBBLE LAND FOR WHEAT.

The trials of different methods of preparing corn ground for seeding wheat was continued during the season of 1904. The conditions of seeding, the variety of grain, thickness, etc., were all similar, the only difference being the fall plowing, spring plowing and spring discing. The spring plowing was done on May 4th. The land was too wet and sticky to plow well. The fall plowed plat was double disced and double harrowed with a peg tooth harrow. The disced ground received exactly the same treatment as the fall plowed corn stubble plat, namely, double discing and double harrowing. The following table gives the detailed results:

TABLE IX.—COMPARISON OF FALL PLOWING, SPRING PLOWING AND SPRING DISCING CORN GROUND FOR WHEAT

Plot No.	Treatment of Ground	1903					1904						Average Yield Per Acre 1903-1904—Bu.
		Yield Per Acre—Bu.	Height of Straw—In.	Per Cent Lodged	Per Cent Rust	Grade	Yield Per Acre—Bu.	Weight Per Bu.—Lbs.	Height of Straw—In.	Per Cent Lodged	Per Cent Rust	Grade	
1	Fall plowing	35.03	40	5	2	1N	18.6	49	40	0	100	No. 4	26.8
2	Spring plowing	34.07	39	1	2	1N	17.4	48	40	0	100	No. 4	25.7
3	Spring discing	40.27	42	15	1	1H	19.2	51	40	0	100	No. 3	29.7

From the above table it will be seen that as an average for two years the spring disced corn land gave nearly three bushels more wheat per acre than corn land which had been fall plowed. The fall plowed land gave slightly more than one bushel greater yield of wheat than the spring plowed piece. It will be noted that the spring discing also had an advantage of one grade over the other two plats.

TEST OF RAPE IN WHEAT FOR FALL PASTURE.

The purpose of this trial was to determine what effect if any, the rape would have upon the wheat crop and the value of rape for pasture after the wheat had been cut. Two plots of an acre each were fall plowed for this test. In the spring the ground was put in good condition for seeding by discing once and harrowing once. The seeding was done on May 14th. The wheat was sown at the rate of six pecks of treated seed per acre and on one plot two pounds of rape seed was added. Both plots were cut on August 22d, at which time no difference could be detected in the appearance of the wheat. No positive evidence in the yield of the grain was obtained, as the rust practically spoiled the wheat crop. At the edges of the plot the rape grew rank enough to interfere somewhat with harvesting the wheat, but after one round had been made with the binder the rape plants encountered had not reached a height of seven inches and consequently gave no trouble. The rape appeared strong and healthy when the wheat was cut. By September 22, when frosts had completely killed the rape, it had made but a slight increase in growth. The following table gives the results of the trial for 1904:

TABLE X.—WHEAT AND RAPE EXPERIMENTS

	Length of Heads	Length of Straw—In.	Weight Per Bu.—Lbs.	Grade	Yield Per Acre—Bu.
Wheat	4 in.	42	50	Rej.	12.9
Wheat and rape	4 in.	42	49	Rej.	13.1

VARIETIES OF WINTER RYE.

The ground for the trial with winter rye was plowed on September 6th. Heavy rains made it very wet and muddy. On September 12th a start was made in seeding, but the ground was too wet to allow reasonable work. On September 21st the seeding was finished, but the ground was not in good condition. On October 1st the rye was up and looked much better than could reasonably have been expected. The results of the trial are presented in the following table:

TABLE XI.—WINTER RYE CROPS OF 1904

Accession No.	Variety	Where From	Stand	Length of Straw—In.	Date Cut	Yield Per Acre—Bu.
959	Winter rye	N. D. Exp. Station	60	54	Aug. 4	20.7
1134	Best winter rye	Northrup, King & Co.	50	42	Aug. 4	18.3

SPRING RYE.

Two varieties of spring rye were seeded on the same date and on ground prepared the same as that described for the varieties of barley. The results are given in table XII:

TABLE XII.—SPRING RYE

Accession No.	Variety	Where From	Stand	Length of Straw—In.	Date Cut	Yield Per Acre—Bu.
1184	Spring rye	Northrup, King & Co.	65	40	Aug. 15	22.3
1424	Spring rye	Northrup, King & Co.	65	40	Aug. 15	18.0

VARIETIES OF OATS.

Thirty-five varieties of oats were planted in the variety trial in 1904. Four of these were grown in the test for the first year. The seed was drilled in with a Monitor double disc drill on May 10th at the rate of ten pecks of dry seed per acre and at a depth of two inches. The seed was treated for smut with formaldehyde before planting. Eighteen-inch alley ways were left between the different plots. Wheat had been produced on the ground the previous season. The ground used for this trial had been fall plowed and put in excellent condition for seeding by discing, followed by a double harrowing.

TABLE XIII.—VARIETIES

Bulletin No.	Accession No.	Variety	Where From	Days Maturing	Length of Straw—In
110	617	U. S. No. 5168	U. S. Dept. of Agriculture	87	32
84	666	U. S. No 5938–60 day	Russia by U. S. Dept. of Agriculture	87	32
	1111	U. S. No. 5168	U. S. Dept. of Agriculture in 1901	87	32
121	1186	English	Wm. Lanxon, Forman, N. D.	96	42
46	233	Selected Black Beauty	N. D. Experiment Station	96	38
111	626	Czar of Russia	H. Hammond, Fifield, Mich	98	38
120	1139	Swedish Select U. S. 9422	Russia by U. S. Dept. of Agriculture	98	34
87	725	Big Four	J. A. Salzer Seed Co.	98	34
89	727	Bow of Promise	J. A. Salzer Seed Co.	98	36
112	637	North Finland U. S. 5139	Koivikko, Finland, by U. S.	96	37
48	325	Zhdarmii U. S. 2963	Russia by U. S. Dept. of Agriculture	98	37
119	1080	Twentieth Century	Salzer Seed Co.	98	37
118	1086	Scottish Chief	L. L. May & Co.	98	37
103	867	Ligowa	Wm. Rennie, Toronto, Can.	98	37
104	868	New Zealand	Wm. Rennie, Toronto, Can.	109	48
	1160	Select Archangel	N. D. Experiment Station	98	44
2	235	Archangel	College Farm	98	44
50	371	Tobolsk U. S. No. 2800	Russia by U. S. Dept. of Agriculture	98	39
42	105	U. S. No. 3	Russia by U. S. Dept. of Agriculture	98	39
100	864	Siberian White	Wm. Rennie, Toronto, Can.	105	42
115	997	White Waverly	Wm. Rennie, Toronto, Can.	104	46
116	1084	Golden Cluster	L. L. May & Co.	104	44
93	768	Lincoln	O. H. Will & Co., Bismarck, N. D.	104	46
102	866	Abundance	Wm. Rennie, Toronto, Can.	104	46
105	869	New Danish White	Wm. Rennie, Toronto, Can.	104	44
98	802	Minn. 202	Minnesota Experiment Station	104	45
94	799	Early Gotham Minn. 26	Minnesota Experiment Station	104	42
54	388	Select Tartarian	N. D. Experiment Station	108	45
39	238	White Russian	Minnesota Experiment Station	108	46
122	387	Select Great Northern	J. A. Salzer Seed Co.	108	46
	1432	Sensational	J. A. Salzer Seed Co.	105	38
64	505	Negro Wonder	Farmers' Seed Co.	105	44
	1425	Belyak	U. S. Dept. of Agriculture	105	44
	1433	Sixty Day	J. A. Salzer Co.	85	28
	1434	National Oat	J. A. Salzer Co.	97	38

OF OATS—CROP OF 1904

Form of Head	Length of Head—In.	Lodged—Per Cent	Rust—Per Cent	Color of Berry	Size of Berry	Form of Berry	Weight Per Bushel—Pounds	Yield Per Acre—Bushels	Average Yield for 1903-1904
Whorled..	5½	25	50	Yellow	Medium	Slender.....	33.0	75.4	63.0
Whorled..	5½	0	50	Light yel..	Small.....	Slender.....	34.5	59.2	50.6
Whorled..	5½	0	50	Yellow	Small.....	Slender.....	35 0	54.6	51.8
Whorled..	8	3	100	White.....	Medium	Short plump	35.0	48.0	44.8
Whorled..	7	0	100	Black	Small.....	Slender.....	31 0	49.1	58.8
Whorled..	8	10	100	White	Large	Short plump	31.0	57 2	61.6
Whorled..	6	3	100	White	Med. large...	Short plump	29.5	54.6	61.4
Whorled .	7	0	75	White.....	Very large...	Long plump.	33.0	54.9	62 7
Whorled..	8	0	10	Yellow	Med. small..	Slender.....	31.0	54.3	58.8
Whorled..	9	2	75	Black.	Medium	Slender.....	29.0	45 0	48.5
Whorled..	7	0	100	White.....	Med. large .	Med.long plp	34 0	63.3	62.5
Whorled..	7	0	100	White.....	Large.....	Plump.....	34.5	62.1	61.0
Whorled..	8	0	90	White	Med. large...	Short plump	32.5	54.3	57.9
Whorled..	8	0	75	White.....	Large.....	Short plump	34.0	58.0	59 8
Side..... .	8	0	10	White.....	Med. large ,.	Medium long	34.0	65.9	66.1
Whorled..	9	0	95	White.....	Medium..	Plump.....	32.0	56.9	58.0
Whorled..	9	0	100	White.....	Med. small..	Short plump	37.5	55.5	61 1
Whorled..	8	0	100	White....	Med. small..	Long plump.	40.0	51.4	60.6
Whorled..	8	0	75	White.....	Very large .	Plump long.	34.0	53.4	58.5
Whorled..	6	0	100	White.....	Large.....	Plump long	32 5	55 5	62.3
Whorled..	6	0	100	White.....	Med. small.	Plump long.	33.0	50.8	62.3
Whorled..	8	3	100	Yellow	Medium.....	Long plump.	31.0	64.1	62.5
Whorled..	8	0	100	White.....	Medium.....	Med. plump.	32 5	65 5	66.3
Whorled..	8	0	100	White.....	Medium.....	Loug plump.	32.0	67.3	69.2
Whorled..	7	0	100	White.....	Medium.....	Long	34.0	63.0	62.5
Whorled..	6	0	100	Yel. white.	Medium.....	Medium long	35 0	64.1	60.7
Whorled..	8	0	100	White.....	Medium.....	Plp med. lg.	33.5	60.4	58.4
Side.....	9	0	10	White.....	Medium.....	Long plump.	37.5	58.7	68.0
Side.....	10	0	10	White.....	Large	Long plump.	37.5	59.0	66.9
Side.....	10	0	10	White.....	Medium.....	Plump long.	36.5	59.3	62.9
Whorled..	7	10	60	Yellowish.	Med large ..	Plump long.	37.0	70.0	
Whorled..	7	5	100	Black	Med. large ..	Lg. slender..	30.0	55 5	57.0
Whorled..	8	0	100	Yellow	Large	Plump..	31.0	56.9	
Whorled..	5½	0	90	White.....	Large	Lg. slender..	35.5	37.3	
Whorled..	6½	0	100	Yel. white.	Large	Plump long.	36.5	59.2	

On May 18th the oats were up nicely and made a good showing. While nearly all of the varieties of oats were attacked by rust, the disease did not seem to lower the yield or grade to any extent. The weight per bushel was nearly up to the average for a good oat season. It will be noticed that the side oats required the longest period for maturing and that they were less affected by rust than the branching kind. Some of the varieties (especially the side oats) showed remarkable rust resisting qualities. The following table groups the fourteen varieties giving the largest yields:

TABLE XIV.—VARIETIES OF OATS GIVING LARGEST YIELDS IN 1904

Bulletin No.	Accession No.	Variety	Days Maturing	Weight Per Bu.—Lbs.	Yield Per Acre—Bu.
110	610	U. S. No. 5168	87	33.0	75.4
	1432	Sensational	105	37.0	70 0
102	866	Abundance	104	32.0	67.3
104	868	New Zealand	109	34 0	65.9
93	768	Lincoln	104	32.5	65.5
116	1084	Golden Cluster	104	31.0	64.1
98	802	Minnesota 202	104	35.0	64.1
48	325	Zhelarmii, U. S. 2963	98	34.0	63.3
105	869	New Danish White	104	34.0	63.0
94	779	Early Gotham Minnesota 26	104	33.5	60.4
119	1090	Twentieth Century	98	34.5	62.1
122	387	Select Great Northern	108	36.5	59.3
	1434	National	97	36.5	59.2
84	666	Sixty Day U. S. No. 5938	87	34.5	59.2

A variety from the group having the shortest period of maturity gave the largest yield, but it will be noted that the late maturing sorts gave uniformly the larger yields in 1904. Table XV gives the varieties having the largest average yields for 1903 and 1904. It will be seen that the variety giving the largest yield in 1904 drops to the sixth place in the average for two years. It is desirable to get an oat that will give a good average yield, rather than one which gives exceptionally large yields in favorable seasons and small yields under adverse conditions.

TABLE XV.—VARIETIES OF OATS GIVING LARGEST AVERAGE YIELD FOR 1903 AND 1904

Bulletin No.	Accession No.	Variety	Average Days Maturing	Av. Weight Per Bu.—Pounds	Av. Yield Per Acre—Bushels
102	866	Abundance	99.0	34.0	69.2
54	388	Select Tartarian	103.5	38.2	68.0
39	238	White Russian	103.5	38.6	66.9
93	768	Lincoln	99.0	34.5	66.3
104	868	New Zealand	100.0	36.1	66.1
110	617	U. S. No 5168	83.0	34.0	63.0
122	387	Select Great Northern	103.5	38.2	62.9
116	1084	Golden Cluster	100.5	33.3	62.5
48	325	Zhelarmii	95.0	36.8	62.5
105	869	New Danish White	99.0	35.8	62.5
87	725	Big Four	95.0	36.5	62.7

A summary has been made and presented herewith which will enable the reader to see exactly what each variety has done for a series of years. The following table presents the results:

TABLE XVI.—VARIETY OF OATS GIVING YIELDS FOR YEARS GROWN

Bulletin No.	Accession No.	Variety	Yield Per Acre Bushels												Average
			1892	1893	1894	1895	1897	1898	1899	1900	1901	1902	1903	1904	
2	235	Archangel	68.0	33.1	54.5	38.0	64.1	70.8	69.1	23.8	42.5	26.3	66.9	55.9	51.8
46 (19)	233	Select Black Beauty	....	27.2	66.7	50.7	45.3	65.4	73.9	15.8	37.2	36.0	68.5	49.1	49.4
54 (83)	388	Tartarian	....	31.2	62.2	53.3	54.1	74.8	64.9	34.8	43.9	63.9	77.3	58.7	55.9
93 (40)	768	Lincoln	....	....	52.5	40.0	53.5	68.8	67.9	26.8	54.5	33.9	66.1	65.5	52.2
94	779	Early Gotham Minn. 26	....	....	59.4	31.3	47.0	75.1	73.1	....	60 5	36.4	56.5	60.4	55.5
39	238	White Russian	....	....	59.7	38.7	37.2	70.4	65.9	38.6	....	55.8	74.9	59.0	55.5
122 (88)	387	Great Northern	....	....	58.2	42.0	47.5	75.8	69 3	24.6	56 0	38.5	69.6	59.3	54.2
42	105	U. S. No 3	....	....	....	....	....	71.5	72.0	25.5	....	41.8	59.5	53.4	53.9
85 (45)	723	Silver Mine	....	....	....	....	....	..	81.1	23.2	60.9	39.2	72.3	41.7	53.0
50	371	Tobolsk U. S. No. 2800	....	....	....	....	....	....	70.6	21 9	....	36.9	69.9	51.4	50.1
48	325	Zhelarmii U. S. No. 2963	....	....	....	....	....	....	70.9	22.0	....	39.2	61.7	63.3	53.2
120	1139	Swedish Select	....	....	..	....	....	.	75.4	23.0	....	30 8	68.2	54.6	50.4
98	802	Minn. No. 202	....	..	....	....	....	....	....	..	67.1	48.2	57.4	64.1	59.2
105	869	New Danish White	....	..	..	..	....	.	....	....	53.9	44.4	62.0	63.0	55.8
102	866	Abundance	....	....	....	....	....	....	....	....	58.9	47 5	71.2	67.3	61.2
100	864	Siberian White	....	....	..	....	....	....	....	..	60.5	47.0	69.1	55.5	58.0
104	868	New Zealand	....	....	....	....	..	..	....	....	49.9	49.3	66.3	65.9	57.8
103	867	Ligowa	....	....	....	....	....	....	....	..	58 3	38.6	61.6	58.0	54.1
89	727	Bow of Promise	....	....	....	....	....	....	....	....	60.3	36.6	63.4	54.3	53.6
87	725	Big Four	....	....	....	....	....	....	....	....	58.8	41.6	70.5	54.9	56.4
84	666	Sixty Day U. S. No. 5938	....	....	....	....	....	....	....	....	50.4	72.2	42.0	59.2	55.9
110	617	U. S. No. 5168	....	....	....	....	....	....	....	....	....	96.9	50.7	75.4	74.3
111	626	Czar of Russia	....	....	....	....	....	....	....	....	.	34.5	66.1	57.2	52.6
112	637	North Finland U. S. 5139	....	....	....	....	....	....	....	....	..	17.3	51.8	45.0	38.2
119	1090	Twentieth Century	....	....	....	....	....	....	....	....	....	41.8	59.9	62.1	54.6
118	1086	Scottish Chief	....	....	....	....	....	....	....	....	....	40.9	61.6	54.3	52.1
115	997	White Waverly	....	....	....	....	....	....	....	....	....	42.3	73.8	50.8	55.6
116	1084	Golden Cluster	....	....	....	....	....	....	....	....	....	38.8	61.0	64.1	54.6
64	505	Negro Wonder	....	....	....	....	....	....	....	....	....	19.9	58.6	55.5	44.6

VARIETIES OF BARLEY.

Twenty-four varieties of barley were sown in the variety trial in 1904. Five of them were new additions which came from the United States department of agriculture. The ground was in good condition, but somewhat hard below the seed bed. The soil was prepared in the manner described for the oat varieties. On May 10th the barley was seeded with a double disc monitor drill, at the rate of ten pecks of dry seed per acre. The seed had previously been treated for smut by the formaldehyde treatment.

TABLE XVII—VARIETIES OF BARLEY—CROP OF 1904

Bulletin No.	Accession No.	Variety	Where From	Days Maturing	Length of Straw—In.	Length of Head—In.	No. Rows Per Head	Length Beard—In.	Lodged—Per Cent	Rust—Per Cent	Size of Berry	Color of Berry	Weight Per Bushel—Pounds	Yield Per Acre—Bushels	Average Yield for 1903-1904
45	720	Great Beardless	J. A. Salzer Seed Co	85	30	1¾	6	...	0	Tr.	Medium...	Lt. yel..	44.5	19½	27.05
51	791	Minn. No. 100	Minnesota Experiment Station..	86	33	2½	6	3½	2	0	Med. small	Lt. yel..	52.0	25½	33.1
58	681	Seneco's Purple	L. F. Seneco, Fargo, N. D	87	28	2	6	3	6	5	Medium...	Purplish	62.0	30.6	33.6
56	966	Common Six-rowed	E.G.Schollander,Montpelier,N D	87	37	2½	6	3	0	0	Medium...	Lt. yel..	50.0	30.2	35.2
	455	Turkestan U. S. No. 977	U. S. Dept. of Agriculture	87	36	1¾	6	4	2	Tr.	Large	Purplish	62½	28.3	22.5
21	149	McEwan's Hulless	Park River, N. D	87	22	3	2	4	5	Tr.	Very large	Amber...	61.0	28.1	31.7
22	107	Russian U. S. No. 5	U. S. Dept. of Agriculture	87	36	2½	6	3½	0	Tr	Small	Lt. yel..	18 0	26.6	32.8
49	789	Bernard's Minn. 28	Minnesota Experiment Station..	87	34	2¼	6	4	0	Tr.	Medium...	Lt. yel..	53 0	29.4	33.7
55	871	Manscheuri Six rowed	Wm. Rennie, Toronto, Can	87	36	3	6	4	0	Tr.	Medium...	Lt. yel..	49 0	31.6	35.4
44	719	Silver King	J. A. Salzer Seed Co	87	34	2	6	4	0	Tr.	Medium...	Lt. yel..	50 0	27.7	33 9
47	787	Mansury Minn. No. 6	Minnesota Experiment Station..	87	33	2¼	6	3	0	Tr.	Medium...	Lt. yel..	47½	30.8	37 6
48	788	Minnesota No. 32	Minnesota Experiment Station..	87	34	2¼	6	4	0	Tr	Medium...	Lt. yel..	49 0	32.0	36.1
50	790	Minnesota No. 87	Minnesota Experiment Station..	87	34	2	6	4	0	Tr.	Med. small	Lt. yel..	50½	30.0	33 4
52	792	Minnesota No. 105	Minnesota Experiment Station..	87	34	2½	6	4	0	Tr.	Med. small	Lt. yel..	49½	32.2	35.1
25	252	Mansury Minn. No. 6	Minnesota Experiment Station..	87	34	2¾	6	4	0	Tr.	Medium ..	Lt. yel..	49.0	34.0	35 5
43	649	Moravian	Hungary by U. S. Dept. of Agri..	87	26	3	2	3	2	0	Med. large	Lt. yel	54.0	33 1	36 6
7	172	Mansury Two-rowed	N. B. A. G. Co	95	29	2½	2	3	0	0	Large	Lt. yel..	54.0	35.9	34.4
53	847	Highland Chief	Northrop, King & Co	104	25	3	2	3	0	0	Large	Lt. yel..	54.0	40.7	41 7
19	171	Success	Minnesota Experiment Station..	104	26	3½	2	4	0	0	Large	Lt. yel..	53.5	34 1	39.7
	1326	Hanna	Arabia by U. S. Dept. of Agri	87	28	3	2	4	0	0	Medium...	Lt. yel..	52.0	25.0	
	1397	Princess	U. S. Dept. of Agriculture	104	26	3½	2	4½	0	0	Med. large	Lt. yel..	51.0	33.0	
	1398	Chevalier	U. S. Dept. of Agriculture	104	26	3	2	4½	0	0	Med. large	Lt. yel	51½	41.5	
	1399	Hannchen	U. S. Dept. of Agriculture	97	24	3	2	4½	0	0	Med. large	Lt. yel	54.0	27.7	
	1400	Princess	U. S. Dept. of Agriculture	97	30	3	2	4½	0	0	Large	Lt. yel..	52½	27.3	

On May 18th the barley was up and making a good showing. The bad effect of the wet spring followed by the dry weather was noticeable in the poor stand of grain on the different trial plats and in the unthrifty appearance of some of the varieties later in the season. It will be noted that the varieties of barley gave yields below the average for a series of years. The low yield can be accounted for by the thin stand, as the grain produced was of an excellent grade, being plump and having large kernels. Water stood upon this variety land in the spring and a little later drying weather "baked" the soil into a hard lumpy condition which probably accounts for its unthrifty condition. No variety of barley was affected by rust to any extent, while the oat and wheat varieties on adjacent and similar soil were badly affected by it. For easy reference the varieties of barley giving the largest yields in 1904 are grouped into the following tabular form:

TABLE XVIII—VARIETIES OF BARLEY GIVING LARGEST YIELD IN 1904

Bulletin No.	Accession No.	Variety	Days Maturing	Weight Per Bushel—Pounds	Yield Per Acre—Bushels
53	847	Highland Chief	104	54.0	40.7
	1398	Chevalier	104	51½	41.5
7	172	Two-rowed Mansury	95	54.0	35.9
19	171	Success	104	53.5	34.1
25	252	Mansury Minn. No. 6	87	49.0	34.0
43	649	Moravian	87	54.0	33.1
	1397	Princess	104	51.0	33.0
52	792	Minnesota No. 105	87	49½	32.2

Further summarized information is given in the following table which tabulates the varieties giving the largest average yields for 1903 and 1904.

TABLE XIX—VARIETIES OF BARLEY GIVING LARGEST AVERAGE YIELD FOR 1903 AND 1904

Bulletin No.	Accession No.	Variety	Average Days Maturing	Average Weight Per Bu.—Pounds	Average Yield Per Acre—Bushels
53	847	Highland Chief	97.5	52.3	41.7
19	171	Success	97.5	52.5	39.7
47	787	Mansury Minnesota No. 6	83.5	46.7	37.6
43	649	Moravian	84.5	52.5	36.6
25	252	Mansury Minnesota No. 6	83.5	48.1	35.5
55	871	Manscheuri Six-rowed	83.0	48.5	35.4
56	966	Common Six rowed	87.5	49.7	35.2
52	792	Minnesota No. 105	83.5	49.0	35.1
48	788	Minnesota 32	83.5	48.7	36 1

The only way to definitely determine which variety is best suited to a particular state or district of country is to try them in comparative tests side by side for a number of years. Favorable conditions may cause a variety to give an exceptionally large yield one year and under less favorable conditions the following season give a small yield. No one can foretell the weather for a season and we must choose upon average results. A variety which gives a high average yield for a long series of years is the one which should be chosen for the value of a given strain is governed chiefly by the yield. The following table gives the yields secured from the different varieties of barley for the years which they have been grown by the Experiment Station:

TABLE XX—VARIETIES OF BARLEY GIVING YIELDS FOR YEARS GROWN

Bulletin No.	Accession No.	Variety	Yield Per Acre—Bushels							Average
			1898	1899	1900	1901	1902	1903	1904	
22	107	Russian U. S. No. 5	42.2	44.6	12.7	....	83.3	39.1	26.6	41.4
49	789	Bernard's Minnesota 28	48.5	....	....	37.6	56.3	38.0	29.4	41.9
49	719	Silver King	47.8	44.6	11.2	38.3	55.3	40.2	27.7	37.9
25	252	Mansury Minnesota No. 6	48.0	50.2	12.5	49.2	56.4	37 0	34 0	41.0
7	172	Mansury Two-rowed	25.6	46.1	16.8	....	57.1	33 0	35.9	35.7
19	171	Success	63.1	....	....	34.8	46.6	45.3	34.1	44.9
21	149	McEwan's Hulless	....	38.1	6.1	32.9	48.1	35.4	28.1	41.6
45	720	Great Beardless	....	....	8 9	34.4	49.3	34.9	19.5	29.4
47	787	Mansury Minnesota No. 6	....	....	11.6	42.1	55.2	44.5	30.8	36.8
51	791	Minnesota No. 100	....	....	....	30.6	59.4	40.7	25.5	39.0
55	871	Manscheuri Six-rowed	....	....	....	45.1	55.7	39.4	31.6	42.9
48	788	Minnesota 32	....	....	....	40.0	53.8	40.4	32.0	41.5
50	790	Minnesota 87	....	....	....	40.4	54.8	36 8	30.0	40.5
52	792	Minnesota 105	....	....	....	40.3	52.4	39.1	32.2	41.0
43	649	Moravian	....	....	....	34.1	48.9	40.2	33.1	39.1
53	847	Highland Chief	....	....	....	25.3	45.0	42.7	40.7	38.4
58	681	Seneco's Purple	....	....	....	....	48.2	36 6	30.6	38.4
56	966	Common Six-rowed	....	....	....	....	63.1	40.3	30.2	44.4
	455	Turkestan U. S. No. 977	....	....	....	....	57.3	16.8	28.3	34.1

VARIETIES OF FLAX.

Thirty-two samples of flax were planted in the variety trial for 1904. They were all seeded on May 19th and 20th at a depth of one to one and a half inches and at a uniform rate of two pecks per acre. The varieties mentioned in the following table, bearing the accession numbers 115 to 1116 inclusive, were treated for wilt using the formaldehyde treatment. The remaining twenty varieties had just been received from the United States department of agriculture and they were not treated for wilt.

TABLE XXI—VARIETIES OF FLAX—CROP OF 1904

Bulletin No.	Accession No.	Variety	Class	Where From	Date Sown	Seed Sown Per Acre—Pecks	Days Maturing	Length of Straw—Inches	Weight Per Bushel—Pounds	Yield Per Acre—Bushels	Average Yield for 1903-1904
7	155	Russian	Seed.	J. A. Salzer Seed Co.	May 19		99	26	53	20.8	18 4
9	608	Selected Russian	Seed.	Selected from 155, N. D. Experiment Station.	May 19		99	26	53	18 0	17 2
10	609	Selected Russian	Seed.	Selected from 155, N. D. Experiment Station	May 19		99	26	53	18.0	17.1
	1215	Selected Seed Flax	Seed.	Selected by N. D. Experiment Station	May 19		99	26	52½	15.5	
	1214	Select Seed	Seed.	Selected by N. D. Experiment Station	May 19		99	26	53	17.3	
	1221	Select Seed	Seed.	Selected by N. D. Experiment Station	May 19		99	26	54	18.6	
13	1120	U. S. No. 8524	Seed.	U. S. Department of Agriculture	May 19		97	30	53	14 2	12.9
14	1133	Common Seed	Seed.	Magill & Co.	May 19		97	28	53½	17.7	19 5
	1183	Russian Seed	Seed.	Currie Bros., Milwaukee, Wis.	May 19		96	32	53½	15.5	
15	969	Select Riga Fiber	Fiber	N. D. Experiment Station	May 19		96	32	54	12.4	10 5
11	1115	Argentine	Seed.	C. Hendrickson, Grafton, N. D.	May 19		99	17 28	53½	16.5	16.4
	1216	Select Fiber	Fiber	N. D. Experiment Station	May 19		96	32	54	13.0	
12	1116	Siberian	Seed.	C. Hendrickson, Grafton, N. D.	May 19		96	30	53	11 2	12.1
	1386	U. S. No. 10378	.....	U. S. Department of Agriculture.	May 19		96	30	53	11.2	
	1357	U. S. No. 9966	.....	U. S. Department of Agriculture.	May 19		96	32	52	11.4	
	1329	U. S. No. 9906	.....	U. S. Department of Agricultuee.	May 20		95	24	53½	20 1	
	1368	U. S. No. 10378	.....	U. S. Department of Agriculture.	May 20		95	29	53	9.6	
	1370	U. S. No. 9989	.....	U. S. Department of Agriculture.	May 20		95	32	54	7.1	
	1340	U. S. No. 9937	.....	U. S. Department of Agriculture.	May 20		97	26	53	19 6	
	1345	U. S. No. 9946	.....	U. S. Department of Agriculture.	May 20		97	24	53	17.7	
	1350	U. S. No. 9957	.....	U. S. Department of Agriculture.	May 20		97	24	53	20 0	
	1347	U. S. No. 9950	.....	U. S. Department of Agriculture.	May 20		97	21	53½	13.7	
	1369	U. S. No. 9982	.....	U. S. Department of Agriculture.	May 20		97	22	53½	16 6	
	1372	U. S. No. 9999	.....	U. S. Department of Agriculture.	May 20		97	23	53	17.5	
	1381	U. S. No. 10014	.....	U. S. Department of Agriculture.	May 20		97	24	53	24.2	
	1375	U. S. No. 10006	.....	U. S. Department of Agriculture.	May 20		97	23	52½	15.5	
	1376	U. S. No. 10005	.....	U. S. Department of Agriculture.	May 20		97	23	53	19 4	
	1383	U. S. No. 10015	.....	U. S. Department of Agriculture.	May 20		97	23	53	18 8	
	1385	U. S. No. 10017	.....	U. S. Department of Agriculture.	May 20		97	23	52½	17 8	
	1351	U. S. No. 9958	.....	U. S. Department of Agriculture.	May 20		97	19	52½	16 5	
	1367	U. S. No. 9980	.....	U. S. Department of Agriculture.	May 20		97	19	52	15.8	
	1384	U. S. No. 10016	.....	U. S. Department of Agriculture.	May 20		97	24	53½	16.1	

The plots were on uniform ground, lay side by side and had uniform eighteen-inch alley ways between the varieties. The flax came up and made good, strong growth throughout the season. It will be seen that only one variety out of the twenty new ones gave a larger yield than the best variety which had been in previous trials. All varieties of flax which had been in the test for three years have been listed in the following table:

TABLE XXII—VARIETIES OF FLAX GIVING YIELDS FOR YEARS GROWN

Bulletin No.	Accession No.	Variety	Yield Per Acre—Bushels						Average
			1898	1899	1900	1902	1903	1904	
14	1133	Common Seed*	19.7	18.6	12.2*	25.3	21.4	17.7	18.9
15	969	Select Riga Fiber	17.6	14.1	10.6*	13.4	8.6	12.4	12.7
7	155	Russian	....	19.0	16.0	25.6	16.3	20.8	19.5
9	608	Select Russian	....	....	16.0	24.1	16.4	18.6	18.6
10	609	Select Russian	....	....	....	25.9	16.2	18.0	20.0
13	1120	U. S. No. 8524	....	....	....	12.0	11.7	14.2	12.6
11	1115	Argentine	....	....	....	22.4	15.8	16.5	18.2
12	1116	Siberian	....	....	....	14.6	12.0	11.2	12.6

* Seed renewed from selections in 1900.
No varieties of flax grown in 1901.

The fibre varieties give small yields in comparison with the seed strains. The fibre varieties do not give sufficient returns for their production where the seed only is utilized. A vast amount of work is being done by the United States department of agriculture and by private concerns to find some cheap way to secure the fibre. In some countries of Europe the fibre is the important part of the crop and the production of seed is of minor consideration. The flax fibre industry in the United States will doubtless develop with the improvement of machinery and with the advance in the price offered for the product. The above table shows the value of careful seed selection, as the seed varieties which have been bred up in the nursery gave the largest yields in every instance.

VARIETIES OF EMMER.

A trial of two varieties of emmer was made in 1904. The emmer was seeded at the rate of twelve pecks of seed per acre on the same date and on soil which had been prepared the same as already described for the varieties of barley.

TABLE XXIII VARIETIES OF EMMER OR SPELT IN 1904

Bulletin No.	Accession No.	Variety	Days Maturing	Weight Per Bushel	Yield Per Acre —Bushels
2	305	North Dakota	104	46.0	*46.0
5	678	U. S. Department of Agriculture	104	43½	*52.9

* Forty pounds per bushel.

While the North Dakota emmer has uniformly given the highest yield in previous trials, the results were reversed this year. The emmer was free from rust, but the growth was retarded in the spring by the wet condition of the soil. As emmer is grown for feed, the following table which gives the comparative yield in pounds per acre for emmer in comparison with average of the best yielding strains of other small grain crops may be of some interest:

TABLE XXIV—SHOWING THE COMPARATIVE YIELD OF EMMER, BARLEY, OATS AND WHEAT FOR SEVEN YEARS

Kind of Grain	1898 Lbs.	1899 Lbs.	1900 Lbs.	1901 Lbs.	1902 Lbs.	1903 Lbs.	1904 Lbs.	Ave. Lbs.
Emmer	2,338	2,291	980	2 518	2,469	2,101	1,976	2,096
Barley	2,326	2,360	844	1,946	2,780	2,079	1,704	2,025
Oats	2,400	2,436	1,058	1,933	1,988	2,378	2,054	2,035
Wheat	2,212	1,552	1,379	1,719	1,590	2,694	984	1,733
Macaroni Wheat	.....	1,948	1,167	1,997	1,943	2,833	1,410	1,883

It will be seen that only a slightly larger yield was obtained from emmer than from oats or barley. If the average for dry seasons only were taken, emmer would make a favorable showing. It is best suited to dry seasons and to the drier sections of the state.

VARIETIES OF BUCKWHEAT.

Two varieties of buckwheat were sown on May 20, 1904, on ground similar to that on which the millet varieties were grown and which was prepared in the same manner. They were seeded at the rate of one and three-fourths bushels per acre. The buckwheat made a very slow ,poor growth and was plowed up on July 7th. At that time it was only three to six inches high and was blossoming.

Buckwheat has not given good crops generally in the trials with it upon the station grounds, and the conditions during the season of 1904 were so adverse that it made an unusually poor crop.

VARIETIES OF MILLET.

Twenty-two varieties of millet seed obtained from different sources were sown on May 20, 1904. They were put in at the rate of two pecks per acre and at a depth of one inch. The ground had been disced once and harrowed twice and was in good condition. The seed was very slow in coming up and had made only a meager, stunted growth by June 15th. The millet varieties were cut on July 28th, as they had made little growth and the weeds were smothering the crop. As far as producing seed is concerned the millet varieties were a complete failure. A few seedings of millet were made later in the year upon ground in the very best condition, but none of them made a good growth.

VARIETIES OF CORN.

Twenty-two varieties of corn and one strain of sorghum constituted the variety trial with corn and fodder growing in 1904. The land had produced oats and barley during the previous season and was fall plowed. On May 21st a good seed bed was prepared by running over the land with a disc, which was followed by a double harrowing with a peg tooth harrow. On May 23d the varieties of corn were planted in hills at thirty-inch intervals in rows forty-four inches apart. The planter dropped from three to five kernels per hill. The corn was up enough to show nicely on June 6th, upon which date it was given a single harrowing with a peg tooth harrow. The corn was worked across the rows on June 15th with a weeder, at which time the corn plants were two to three inches high. The soil was in good condition after the weeder had been used upon it.

Three weeks after planting it was noted that numbers 1409, 1419 and 1420 had made an uneven stand and that they were making a slow growth. On June 21st the corn was given a cultivation, on June 28th it was run over with a weeder and on July 5th all of the

weeds remaining were removed with hoes in order that no variety should have any handicap whatever. The varieties of corn were cultivated on July 15th and again on July 28th, notwithstanding the fact that upon the latter date a number of the stalks were broken off by the cultivator beams.

The cultivation implements used were the Hallock weeder, an iron lever peg tooth harrow and a five-shovel cultivator set to burrow about two inches deep. Killing frost occurred on September 11th.

The following table gives the detailed results of the trial:

TABLE XXV—VARIETIES

Bulletin No.	Accession Number	Variety	Class	Where From
100	1156	N. D. Station No. 100	Yellow dent.	N. D. Experiment Station
119	950	Golden Dent	Yellow dent.	Walter Russell, Fargo, N. D.
	1406	Pride of the North	Yellow dent.	Northrup, King & Co., Minneapolis
	1407	N. D. Yellow Dent	Yellow dent.	Northrup, King & Co., Minneapolis
	1408	Minnesota Early Dent	Yellow dent.	Northrop, King & Co., Minneapolis
	1409	Minnesota King	Yellow dent.	Northrup, King & Co., Minneapolis
	1410	Bloody Butcher	Red dent	Northrup, King & Co., Minneapolis
	1411	Rustler Early White Dent	White dent.	Northrup, King & Co., Minneapolis
	1402	Northwestern	Red dent	O. H. Will & Co., Bismarck, N. D.
	1444	Sure Crop	Yellow dent.	L. L. May & Co.
	1413	Longfellow	Yellow flint.	Northrup, King & Co., Minneapolis
	1414	Smut Nose	Yellow flint.	Northrup, King & Co., Minneapolis
	1415	Triumph	Yellow flint.	Northrup, King & Co., Minneapolis
	1416	King Phillip	Red flint	Northrup, King & Co., Minneapolis
	1404	Olds' Mammoth	Red flint	L. L. Olds, Clinton, Wis.
	1403	Will's Dakota	White flint.	O. H. Will & Co., Bismarck, N. D.
	1401	Will's Gebu	Yellow flint.	O. H. Will & Co., Bismarck, N. D.
	1412	Squaw Flint	Black flint.	Northrup, King & Co., Minneapolis
	1435	Dakota White Flint	White flint.	J. A. Salzer Co.
	1417	Elephant Fodder	Yellow dent.	Northrup, King & Co., Minneapolis
	1418	Giant Fodder	White dent.	Northrup, King & Co., Minneapolis
	1419	Stowell's Evergreen	Sweet	Northrup, King & Co., Minneapolis
	1420	Sorghum	Sorghum	Northrup, King & Co., Minneapolis

† Not husked.

* Fodder crop.

OF CORN—CROP OF 1904

Stand	Stage of Maturity at Frost	Average No. Stalks Per Hill	Height of Stalks—Inches	Height of Ears—Inches	Yield Fodder Per Acre—Pounds	Yield of Ears Per Acre—Lbs.	
						Ripe	Soft
Good	Dough to ripe	3	67	21	4,520	1,272	506
Good	Dough to ripe	3	67	27	5,136	643	904
Good	Milk to hard dough	3-4	72	36	7,808	.....	1,479
Good	Milk to dough	3	66	34	6,986	.....	1,369
Good	Milk to dough	3	66	21	7,945	.....	1,410
Very poor	Dough to ripe	2	67	21	2,602	.....	685
Good	Dough	4	69	24	6,027	425	1,438
Good	Milk	3	68	27	7,534	.....	2,068
Good	Dough to ripe	3	69	16	5,205	958	1,249
Good	Silk	3	45	42	9,313	.....	1,000
Good	Dough to ripe	4	72	34	7,123	301	1,249
Good	Dough	5	63	23	6,712	219	1,329
Good	Dough	5	63	26	5,548	232	1,506
Good	Dough	5	65	24	6,712	301	1,191
Good	Silk	4	74	30	7,767	.....	1,000
Good	Dough to ripe	4	47	14	5,000	1,397	573
Good	Dough to ripe	4	45	13	4,931	1,335	616
Good	Silk to milk	4	69	24	9,316	.....	479
Good	Milk	4	69	27	8,150	†	
Good	No ears formed	3	81	No ears	9,316	*	
Good	No ears formed	3	81	No ears	9,316	*	
Fair	Silk	3	61	24	5,890	*	
Very Poor	No ears	5-10	52	No ears	2,671	*	

From the above table it will be seen that in the proportion of ripe ears produced or in the degree of ripeness the varieties rank as follows: Wills Dakota, Gehu, North Dakota No. 100 (bred up from Minnesota King), Northwestern Dent, Golden Dent, Bloody Butcher and Longfellow.

Unfortunately, through an oversight, Mercer—an early strain as shown by past trials at this station—was not included in the 1904 variety trial.

The fodder was practically uniform in the degree of dryness when the weights were taken. Press of work and a lack of drying facilities prevented the determination of the actual dry matter in the various samples. It is probable that the large, late maturing samples actually carried more water than the earlier strains. The amount of soft or immature corn contained in a variety would also increase the weight of a given sample by increasing the amount of water which it contained.

DRILLED CORN COMPARED WITH CORN IN HILLS.

The comparison of corn grown in drills at different distances apart with that of corn grown in hills, the rows standing forty-two and twenty-two inches apart respectively, was carried on in the season of 1904. The trial is really a continuation of one which has been running for six years and is an interesting one in many of its details. The following systematized information in tabular form gives the yield, height and other points of interest carried out in this trial:

TABLE XXVI—PLANTING CORN IN HILLS VS. PLANTING IN DRILLS—CROP OF 1904

Plot No.	How Planted	Height of Stalk—In.	Stage of Maturing at Frost	Yield Per Acre Air Dry Fodder—Lbs.	Av. Yield Per Acre Air Dry Fodder—Lbs.	
					Average for Three Years	Average for Seven Years
1	Drills 6 inches apart	36	No ears.	10,682	7,716	7,599
2	Drills 12 inches apart	48	No ears.	10,409	7,546	6,938
3	Drills 18 inches apart	60	No ears.	9,625	6,562	
4	Drills 24 inches apart	67	Milk to dough	10,541	6,991	
5	Drills 30 inches apart	69	Milk to dough	8,920	6 078	6,143
6	Drills 36 inches apart	68	Milk to dough	8,667	6,364	6,375
7	Drills 42 inches apart	66	Milk to dough	6,357	5,383	
8	Hills, rows 44 inches apart	66	Dough to hard	7,116	5,413	
9	Hills, rows 22 inches apart	69	Dough to hard	8,836	7,146	

A consultation of the table shows that corn planted in drills thirty inches apart with the stalks growing close together in the drill row reached the greatest height of any of the plants and measured five

feet nine inches. That which was sown in ordinary wheat drills, six inches apart and thick in the row, reached the least height, the stalks measuring just three feet. The gradual increase in height from three to five feet nine inches—the mark which the thirty-inch trial plot showed—seems a logical result from crowding the thick planted corn together, as it would naturally produce a dwarfing effect. It is interesting to note further that the yield of air dry fodder in the seven years' trial is the greatest from plots which were planted in six-inch drills. It is also interesting to note that corn planted in hills where the rows were twenty-two inches apart made a very much better showing than that which was grown in rows forty-two inches apart. Fodder which grew in drill rows thirty and thirty-six inches apart made good yields, and, by reason of growing far enough apart to allow of cultivation, it has an advantage over thickly seeded plots. The cultivation of corn during the growing season will conserve more moisture for the crop than can be done where the drill rows are too closely crowded together to permit the use of a corn cultivator. Thick planted corn has the advantage of producing small stalks which are less harsh than larger growing ones, and on that account are more palatable and surer to be consumed when fed to live stock. It is somewhat difficult to cut and cure corn fodder which has grown in six-inch drills, as no machine seems to work in it satisfactorily, except the ordinary mower and the large stems contain so much sap that it is hard to dry them out thoroughly enough to make it safe to stack them for fodder.

Another portion of the trial with drilled corn consists of a comparison of corn planted in drill rows, three feet eight inches apart, with the stalks growing at from six to thirty-six-inch intervals in the drill rows. This trial has been carried on for four years and gives average results that are worthy of careful study. The facts are presented in systematic order in the following tabular form:

TABLE XXVII—THICKNESS OF PLANTING CORN IN DRILL ROWS—CROP OF 1904

Plot No.	How Planted	Height of Stalk—In.	Length of Ears—In.	Per Cent Ripe Ears	Yield Per Acre 1904		Av. for Three Years—1902 to 1904 Inc.		Ave for Five Years	
					Air Dry Fodder—Lbs.	Ears—Bu.	Air Dry Fodder—Lbs.	Ears—Bu.	Air Dry Fodder—Lbs.	Ears—Bu.
1	3⅜ feet by 6 inches.....	60	5	59	5,685	30 4	6,511	30.5	6,117	33.9
2	3⅜ feet by 10 inches.....	60	5¼	55	5,548	30.3	5,636	29 4	5,210	31.4
3	3⅜ feet by 12 inches.....	6[illegible]	5⅜	63	4,794	27 1	5,464	23.9	5.0 0	27.8
4	3⅜ feet by 14 inches.....	60	5⅜	64	4,863	25.9	6,050	24 4	4,957	26.1
5	3⅜ feet by 16 inches.....	60	5¾	70	4,931	24.8	4,883	21.5	4 :6	23.6
6	3⅜ feet by 18 inches.....	60	6	65	5,068	24.8	4,734	21.4	4 100	23.0
7	3⅜ feet by 24 inches.....	60	6	64	4,315	20.7	4,117	15.9	3,410	17.2
8	3⅜ feet by 30 in h s.....	6[illegible]	6¼	64	3,287	16.1	3,417	15.3	*3,117	*16.5
9	3⅜ feet by 36 inches	60	6¼	63	2,671	12 9	2,971	14.3	*2,536	*12.6

* Average for four years.

An inspection of the above table shows a striking contrast in the yield of ears per acre. Beginning with nearly thirty-four bushels of ear corn from drill rows which produced corn stalks at six-inch intervals in the row, we find a gradual decrease in the yield of ears until we reach the plot having an interspace of thirty-six inches between the stalks. The yield of fodder also diminishes with nearly the same degree of regularity as the spaces between the stalks of corn in the row widen. It may also be seen that five to six and one-half inches represent the extreme variation in the length of the ears produced, and that there is no shortening of stalks to be charged to thicker seeding. The ears of corn produced were appreciably longer on the thinner planted plots which had the stalks sixteen inches apart in the row than they were upon those that grew stalks of corn thicker than that interspace represents. The differences do not run regularly enough to justify a decided statement of a principle, but it is a significant fact that the thicker planted plots produced ears one and one-fourth inches shorter on the average than the longest ears of corn in the trial, and that the plots having stalks thirty to thirty-six inches apart in the rows produced as long ears as were grown upon any of the plots and that the plants growing with eighteen and twenty-four-inch intervals yielded ears of nearly maximum length.

THICKNESS OF PLANTING CORN IN HILLS.

The best thickness to plant corn in the hill and in the drill row constitute important questions which are being solved for this district of country. The station has continued its efforts in that field of investigation and is able to present herewith the results for five seasons:

TABLE XXVIII—NUMBER OF KERNELS IN A HILL—CROP OF 1904

Plot No.	Number of Stalks	Stage of Maturity at Frost	Height of Stalks—In.	Length of Ears—In.	Per Cent Ripe Ears	Yield Per Acre		Average for Five Years	
						Air Dry Fodder—Lbs.	Ears—Bu.	Air Dry Fodder—Lbs.	Ears—Bu.
1	One	Dough to hard	69	6¼	65	3,150	14.1	3,171	13.8
2	Two	Dough to hard	60	6	63	4,383	24.1	3,955	22.6
3	Three	Dough to hard	60	5¾	59	4,794	25.8	4,655	26.6
4	Four	Dough to hard	66	5¼	57	5,068	25.4	5,120	27.1
5	Five	Dough to hard	66	5	58	5,276	20 9	5,574	28.2
6	Six	Dough to hard	60	4¾	56	5,410	15.6	5,887	28.7

From the above table it will be seen that corn which produced six stalks in a hill gave a higher yield of both ears and fodder per acre, as an average result for five years' trial, than did that which was planted more thinly. The percentage of ripe corn in the seasons of 1903 and 1904 was regularly reduced when the thickness was greater than two stalks in a hill. It will also be noticed that the

ears were shortened as the thickness in the hill was increased, making the extreme variation range from four and three-fourths to six and one-fourth inches. The size or calibre of the stalks diminish with the thickness of planting. The station has taken up the question of determining the percentage or the proportion of stalks which cattle will refuse when thick planted and thin planted corn is offered them, and the results will be incorporated in some future report. The above results present facts which should be used by the corn growers of the state. The station cannot say of the thick and thin planting that one is better than the other, as too much depends upon how the grower is situated, but the trial shows that certain results may be expected from thin planting and certain results from thick planting, and the corn grower can understand from the trial what the results will likely be if he adopts one plan or the other.

DATES OF PLANTING CORN IN DRILL ROWS.

The results from four years' work in comparing corn planted at seven-day intervals for six weeks following the date of May 18th are presented herewith. The questions, how late may corn be safely planted for fodder, and what will the exact result be as measured by the ripeness, the yield of fodder, the percentage of moisture in the crop, the class or grade of grain and fodder and the difficulties which will be met in caring for and saving the crop, frequently arise among our fodder producers and grain growers. The following table gives the results in detail for both the six-inch and the forty-two-inch drill-rowed plats which constituted the trial:

TABLE XXIX—DIFFERENT DATES OF SOWING CORN—CROP OF 1904

Plot No.	Date of Planting	Stand	Height of Stalks—In.	Stage of Maturity at Frost	Yield Per Acre of Air Dry Fodder—Lbs.				Average Yield
					1901	1902	1903	1904	
SIX-INCH DRILLS									
1	May 23...	Very heavy..	48	Silk	6,785	5,057	8,560	7,471	6,963
2	May 30...	Very heavy..	53	Silk	9,614	3,838	5,406	5,857	6,179
3	June 6...	Very heavy..	48	No ears formed.	8,170	4,861	6,594	4,714	6,085
4	June 13..	Very heavy..	46	No ears formed.	9,701	2,546	7,228	6,357	6,458
5	June 20..	Very heavy..	40	No ears formed.	7,117	4,069	6,105	5,571	5,715
6	June 27..	Very heavy..	56	No ears formed.	9,044	*.....	7,782	6,071	
FORTY-TWO-INCH DRILLS									
1	May 23...	Very heavy..	60	Milk to dough ..	5,492	4,001	†.....	5,357	
2	May 30...	Very heavy..	70	Milk to dough ..	5,414	2,468	†.....	5,213	
3	June 6...	Very heavy..	47	Milk.....	6,172	2,105	6,906	4,761	4,986
4	June 13..	Very heavy..	50	Milk.....	6,445	1,149	5,094	4,357	4,261
5	June 20..	Very heavy..	46	Ears just form'g	5,637	2,671	4,720	4,821	4,462
6	June 27..	Very heavy..	53	No ears.....	6,103	*.....	2,967	4,142	

* Only five plots grown.
† Weights accidentally lost.

By consulting the table presented above it will be noted that the corn planted May 23d and May 30th in six-inch drills reached the silking stage. It will be noted that the late planted corn from drill rows six inches apart yielded slightly less fodder as an average for four years than the earlier planting, and also that the late planted fodder yielded over two and one-third tons of dry fodder per acre. In this, as in several other trials with corn, the poor facilities which the station buildings afford for handling experimental fodder and grain force us to record blank columns with a foot note giving the information that the samples were destroyed by vermin or by other unavoidable occurrences. Corn planted in the trial of different dates of seeding in forty-two-inch drill rows, gives much the same comparative results as come from the trial of seeding it in six-inch drills. A greater difference is recorded for the degree of maturity or ripeness of the early and late sown plots. Corn planted in drill rows forty-two inches apart produced a considerable amount of its value in the ears of corn which it formed, and the difference in the stage of maturity of the corn from the different trial plots represents more of feeding value than it does when it is from thicker seeding. The percentage of moisture which the late seeded corn is likely to contain is less a hindrance in the fodder produced from forty-two-inch drills than it is in fodder grown in drills six inches apart. The corn from forty-two-inch drills can be bound, shocked and field cured in the ordinary way without much danger of heating or molting, while corn planted in six-inch drills must be cut down with a mower and allowed to lie in the swath until it has dried sufficiently to permit of stacking. The shorter days and the cooler weather, which come at the season when frosts occur and the crop must be harvested, cause great difficulty in curing and drying out the fodder from thick sown corn.

A CULTIVATION TRIAL WITH CORN.

For five years the station has carried on a series of cultivation trials as a part of the corn work undertaken. The trials comprise a comparison of deep cultivation, which is commonly produced by using the pointed shovel cultivator during the entire season, with another plot of corn which is cultivated shallow during the first half of the season and cultivated deep with a pointed shovel cultivator during the latter half of the season. A third trial plot was cultivated deep during the first half of the season and shallow during the latter part of the corn cultivating period. The fourth plot in the trial was cultivated with a surface cultivator each time during the season. The corn in all of these trials was planted at the same time and under the same conditions in every way. The following summarized results give in tabular form the facts concerning the trial:

TABLE XXX—CULTIVATION EXPERIMENT WITH CORN—CROP OF 1904

Plot No.	Method of Culture	Stage of Maturity at Frost	Height of Stalks—In.	Length of Ears—In.	Per Cent Ripe Ears	Yield Per Acre		Average for Five Years	
						Air Dry Fodder—Lbs.	Ears—Bu.	Air Dry Fodder—Lbs.	Ears—Bu.
1	Deep	Dough to ripe.	64	4 to 5	24	5,291	24.9	4,732	30.3
2	Shallow early; deep late	Dough to ripe.	64	4 to 5	28	6,659	34 4	5,101	34.9
3	Deep early; shallow late	Dough to ripe.	64	4 to 5	27	6,798	33.6	4,853	31.5
4	Shallow	Dough to ripe.	64	4 to 5	32	6,113	29.4	5,269	32.8

From the above table it will be seen that the yield of dry fodder as an average for five years gives the greatest yield of fodder from shallow cultivation. It will also be seen that there was little difference between the other three plots as measured by the yield of air dry fodder. The result of the trial for one of the earlier seasons indicated that deep cultivation late in the season has a tendency to cause an early ripening of the ears, but the results for the season of 1903 indicate that the killing frosts which occurred September 15th on that year found the shallow cultivated plot with the largest portion of ripe ears, while the season of 1904 gave no differences in the degree at ripeness at frost.

VARIETIES OF POTATOES.

Small plots of each of eighteen varieties of potatoes were planted in order that the seed of the best strains might be preserved until such time as facilities for potato growing experiments can be provided by the institution. Although the plots were very small, they were uniform and the yield was accurately determined. All of the facts obtained in the trial are given in the following table:

TABLE XXXI—VARIETIES OF

Bulletin No.	Accession No.	Variety	Where From
	595	Main Crop	Ireland
87	903	Earliest Six Weeks	Wm. Rennie, Toronto, Can
95	943	Banner	L. L. Olds, Clinton, Wis
96	944	Hammond's Wonderful	L. L. Olds, Clinton, Wis
103	992	Early Harvest	Wm. Rennie, Toronto, Can
104	993	Quick Crop	Wm. Rennie, Toronto, Can
86	749	Daughter of Rose	J. A. Salzer Seed Co
90	906	Rose of the North	Wm. Rennie, Toronto, Can
84	747	All the Year Around	J. A. Salzer Seed Co
97	945	Maule's Commercial	L. L. Olds, Clinton, Wis
106	1079	Early Rose	L. L. May & Co
110	1083	May's Netted Gem	L. L. May & Co
108	1081	Early Minnesota	L. L. May & Co
105	1078	Astonisher	L. L. May & Co
107	1080	Early Fortune	L. L. May & Co
	1189	Millet's Early Bird	J. W. Millet, Bismarck, N. D.
	1222	Gold Coin	Burpee & Co
49	272	Early Ohio	North Dakota Experiment Station

POTATOES—CROP OF 1904

Stage of Maturity at Frost	Average Size of Tubers	Shape	Depth of Eyes	Color	Marketable—Per Cent	Small—Per Cent	Yield Per Acre—Bushels
Dead ripe	Small to med.	Oval	Med. shallow	Red	90	10	142.0
Dead ripe	Medium	Long oval	Med. shallow	Red	91	9	159.3
Green	Large	Flat oval	Med. deep	White	100	0	263.1
Ripe	Medium	Oblong	Very shallow.	White.	95	5	210.8
Ripe	Medium	Long oval	Shallow	White.	97	3	188.4
Ripe	Medium	Roundish	Small, deep.	Red	93	7	200.8
Ripe	Small	Long	Shallow	Red	87	13	213.3
Ripe	Medium	Oblong	Shallow	Red	94	6	168.4
Ripe	Medium	Round oblong.	Shallow	Red	86	14	145.2
Ripe	Very large	Long flat	Medium	Red	100	0	172.6
Ripe	Med. small	Long	Deep	Red	85	15	149.4
Ripe	Med. large	Long	Very shallow.	White.	98	2	200.8
Ripe	Medium	Round	Medium	Red	98	2	141.9
Green	Large	Long	Medium	White.	94	6	142.7
Ripe	Medium	Long	Medium	Red	80	20	141.1
Ripe	Medium	Round	Shallow	White.	90	10	121.1
Green	Large	Oval	Shallow	White.	95	5	157.7
Ripe	Med. small	Oval	Medium	Red	88	12	124.5

The ground was prepared in the same manner as described for the corn varieties. The seed was treated with a formaldehyde solution for scab on May 13th and cut ready for planting on May 16th. On May 18th it was planted two pieces in a hill, the hills being eighteen to twenty-four inches apart and the rows forty-four inches apart. During the summer the potatoes received the following treatment: Harrowed on June 7th, cultivated twice with a weeder on June 15th, at which time the potatoes were coming up nicely, cultivated with a weeder on June 25th and cultivated with a corn cultivator on July 1st and July 19th. The potatoes were dug on October 5th. They were all remarkably clean and free from scab. A few of the best hills from each variety were saved and stored in a neighbor's root cellar for the winter.

VARIETIES OF PEAS.

On May 16th short rows of each of twenty-three varieties of field peas were drilled in with a Planet, Jr., drill. The peas had fully ripened before frost came and were cut on September 14th. Each of the strains made a long and strong growth of vines, reaching a length of four to five feet. The plots were too small to permit of accurately estimating the yield per acre, but the results were very promising so far as the yield of both hay and seed was concerned.

LIVE STOCK SCORE CARDS.

Score cards used in judging live stock embrace a scale of points which helps unify and harmonize the discussion upon the animal forms considered. They also serve a good purpose in making the scores agree upon the relative values of the different parts of the animals criticised or compared. The animal score cards used at this institution follow:

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 1—Light Horses.

Scale of Points—For Gelding	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
Age			
General Appearance—			
Weight, ... lbs. actual			
Height, 16 hands; estimated hands ..., actual ...	2		
Form, type ... symmetrical, smooth, stylish	4		
Quality, bone clean, firm; tendons, defined; hair and skin fine	8		
Temperament, active, good disposition	5		
Head and Neck—			
Head, lean, straight	1		
Muzzle, fine; nostrils large; lips thin, even; teeth sound	1		
Eyes, full, bright, clear, large	1		
Forehead, broad, full	2		
Ears, medium size, pointed, well carried	1		
Neck, muscled; crest high; throatlatch fine, windpipe large	2		
Forequarters—			
Shoulder, long, smooth, oblique, extending into back	3		
Arm, short, thrown forward	1		
Forearm, muscled, long, wide	2		
Knees, clean, wide, straight, deep, strongly supported	2		
Cannons, short, wide, sinews large, set back ...	2		
Fetlocks, wide, straight	1		
Pasterns, strong; angle with ground, 45 deg. ..	3		
Feet, medium, even size; horn dense; frog large, bars strong, sole concave, heel wide, high ..	8		
Body—			
Chest, deep, low, large girth	3		
Ribs, long, sprung, close	2		
Back, straight, short, broad, muscled	2		
Loins, wide, short, thick	2		
Underline, long, flank let down	1		
Hindquarters—			
Hips, smooth, wide, level	2		
Croup, long, wide, muscular	2		
Tail, attached high, well carried	1		
Thighs, long, muscular, spread, open angled ..	2		
Quarters, heavily muscled, deep	3		
Gaskins or lower thighs, long, wide, muscular..	2		
Hocks, clearly defined, wide, straight	8		
Cannons, short, wide, sinews large, set back..	2		
Fetlocks, wide, straight	1		
Pasterns, strong, sloping	2		

Students' Score Card No. 1—Continued.

Scale of Points—For Gelding	Perfect Score	Points Deficient	
		Stud't's Score	Cor. rected
Feet, medium, even size; horn dense; frog large, elastic; bars strong; sole concave, heel wide, high	6		
Action, step smooth, long, active; trot rapid, straight, regular	10		
Total	100		
Estimated market value			

Animal ..... Date .....
Student ..... Standing .....

(After John A. Craig.)

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 2—Draft Horses.

Scale of Points—For Gelding	Perfect Score	Points Deficient	
		Stud't's Score	Cor-rected
Age			
General Appearance—			
Height, estimated ....., actual			
Weight, over 1,500 lbs.; estimated ..... lbs.; score according to age	4		
Form, broad, massive, proportioned	4		
Quality, bone smooth, hard; tendons, lean; hair and skin fine	8		
Temperament, energetic, good disposition	5		
Head and Neck—			
Head, lean, medium size	1		
Muzzle, fine; nostrils large; lips thin, even	1		
Eyes, full, bright, clear	1		
Forehead, broad, full	2		
Ears, medium size, well carried	1		
Neck, muscled; crest high; throatlatch fine, windpipe large	1		
Forequarters—			
Shoulder, sloping, smooth, snug, extending into back	3		
Arm, short, thrown back	1		
Forearm, heavily muscled, long, wide	2		
Knees, wide, clean-cut, straight, deep, strongly			

Students' Score Card No. 2—Continued.

Scale of Points—For Gelding	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
supported	2		
Cannons, short, lean, wide, sinews large, set back	2		
Fetlocks, wide, straight, strong	1		
Pasterns, sloping, lengthy, strong	3		
Feet, large, even size; horn dense; sole concave, bars strong, frog large, elastic; heel wide, one-half length of toe and vertical to ground	8		
Body—			
Chest, deep, wide, low, large girth	2		
Ribs, long, sprung, close	2		
Back, straight, short, broad, muscular	2		
Loins, wide, short, thick, straight	2		
Underline, flank low	1		
Hindquarters—			
Hips, smooth, wide	2		
Croup, wide, muscular	3		
Tail, attached high, well carried	1		
Thighs, muscular	2		
Quarters, heavily muscled, deep	4		
Gaskins or lower thighs, wide, muscled	2		
Hocks, clear-cut, wide, straight	8		
Cannons, short, wide, sinews large, set back	2		
Fetlocks, wide, straight, strong	1		
Pasterns, sloping, strong, lengthy	2		
Feet, large, even size; horn dense; dark color; sole concave, bars strong; frog large, elastic; heel wide; one-half length of toe and vertical to ground	6		
Action, step smooth, quick, long; trot rapid, straight, regular	8		
Total	100		
Estimated market value			

Animal ..... Date .....
Student ..... Standing .....

(After John A. Craig.)

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 3—Dairy Cattle.

Scale of Points—Cow	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
General Appearance—			
Weight, estimated ..... lbs.; actual ..... lbs.			
Form, wedge shaped, as viewed from front, side and top; weight 800 to 1,000 lbs.	8	.....	.....
Quality, hair fine, soft, skin mellow, loose, medium thickness, secretion yellow, bone clean.	8	.....	.....
Temperament, nervous, indicated by lean appearance	5	.....	.....
Head and Neck—			
Muzzle, clean cut; mouth large; nostrils large..	1	.....	.....
Eyes, large, bright	1	.....	.....
Face, lean, long, quiet expression	1	.....	.....
Forehead, broad, full	2	.....	.....
Ears, medium size, yellow inside, fine texture ..	1	.....	.....
Neck, fine, medium length, throat clean, light dewlap	2	.....	.....
Forequarters—			
Withers, lean, thin	1	.....	.....
Shoulders, light, oblique	2	.....	.....
Legs, straight, short, shank fine	3	.....	.....
Body—			
Chest, deep, low, girth large.....	8	.....	.....
Ribs, broad, long, wide apart, large stomach ..	10	.....	.....
Back, lean, straight, open jointed	3	.....	.....
Loins, broad	3	.....	.....
Navel, large	2	.....	.....
Hindquarters—			
Hips, far apart	2	.....	.....
Rump, long, wide	2	.....	.....
Pin bones or thurls, high, wide apart	1	.....	.....
Tail, long, slim, fine switch	1	.....	.....
Thighs, thin, long	2	.....	.....
Escutcheon, spreading over thighs, extending high and wide, large, thick ovals	2	.....	.....
Udder, long, attached high and full behind, extending far in front and full, quarters even, free from fleshiness	16	.....	.....
Teats, large, evenly placed	4	.....	.....
Milk veins, large, tortuous, large milk wells..	6	.....	.....
Legs, straight, far apart, shank fine	3	.....	.....
Total	100	.....	.....

Animal ..... Date .....
Student ..... Standing .....

(After John A. Craig.)

Student's Score Card No. 4—Beef Cattle.

Scale of Points—Steer	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
General Appearance—			
Weight, estimated .... lbs; according to age ...	6		
Form, straight top line and underline; deep, broad, low, set stylish	8		
Quality, firm handling; hair fine, pliable skin, dense bone, evenly fleshed	8		
Temperament, quiet	5		
Head and Neck—			
Muzzle, mouth large; lips thin; nostrils large ..	1		
Eyes, large, clear, placid	1		
Face, short, quiet expression	1		
Forehead, broad, full	1		
Ears, medium size, fine texture	1		
Neck, thick, short, throat clean	2		
Forequarters—			
Shoulder vein full	3		
Shoulder, covered with flesh, compact on top, smug	4		
Brisket, advanced, breast wide	2		
Dewlap, skin not too loose and drooping	1		
Legs, straight, short, arm full, shank fine, smooth	3		
Body—			
Chest, full, deep, wide, girth large, crops full ..	8		
Ribs, long, arched, thickly fleshed	6		
Back, broad, straight	6		
Loins, thick, broad	5		
Flank, full, even with underline	4		
Hindquarters—			
Hips, smoothly covered, distance apart in proportion with other parts	4		
Rump, long, even, wide; tail head smooth, not patchy	5		
Pin bones, not prominent, far apart	3		
Thighs, full	3		
Twist, deep, plump	4		
Purse, full, indicating fleshiness	2		
Legs, straight, short, shank fine; smooth	3		
Total	100		

Animal ..... Date .....
Student ..... Standing .....

(After John A. Craig.)

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 5—Mutton Sheep.

Scale of Points--Wether	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
Age ..... Teeth			
General Appearance—			
Weight, estimated ..... lbs.; actual ..... lbs. according to age	6		
Form, low, long, symmetrical, compact	8		
Quality, clean, strong bone, silky hair	8		
Temperament, quiet	5		
Head and Neck—			
Muzzle, fine; mouth large; lips thin; nostrils large	1		
Eyes, bright, full	1		
Face, short, quiet expression	1		
Forehead, broad	1		
Ears, fine, erect	1		
Neck, thick, short	1		
Forequarters—			
Shoulder vein, full	2		
Shoulder, covered, compact	3		
Brisket, projecting forward, breast wide	2		
Legs, straight, short, wide apart, strong; forearm full, shank smooth	3		
Body—			
Chest, wide, deep	3		
Back, straight, wide	4		
Loins, thick, broad	3		
Ribs, arched, deep	3		
Flank, low, thick, making underline straight ..	2		
Hindquarters—			
Hips, far apart, smooth	3		
Rump, long, level, wide	3		
Thighs, full	3		
Twist, deep, plump	4		
Purse full, indicating condition	2		
Legs, straight, short, strong; shank smooth	3		
Constitution—			
Girth, large	3		
Skin, pink color	3		
Fleece, dense and even over body, yolk abundant	4		
Wool—			
Quantity, long, dense, even	6		
Quality, fine, soft, pure, even	4		
Condition, bright, strong, clean	4		
Total	100		

Animal ..... Date .....

Student ..... Standing .....

(After John A. Craig.)

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 6—Swine.

Scale of Points—Barrow	Perfect Score	Points Deficient	
		Stud't's Score	Corrected
General Appearance—			
Weight, estimated ..... lbs.; actual ..... lbs. score according to age	6	.....	.....
Form, deep, broad, low, long, symmetrical, compact; standing squarely on legs	8	.....	.....
Quality, bone clean, hair silky, skin fine	8	.....	.....
Disposition, quiet	5	.....	.....
Head and Neck—			
Snout, medium length; not coarse	1	.....	.....
Eyes, full, mild, bright, large	1	.....	.....
Face, short, cheeks, full	1	.....	.....
Ears, fine, medium size, soft	1	.....	.....
Jowl, strong, neat, broad	1	.....	.....
Neck, thick, medium length	1	.....	.....
Forequarters—			
Shoulder vein, full	2	.....	.....
Shoulders, broad, deep, full; compact on top..	8	.....	.....
Breast, advanced, wide	2	.....	.....
Legs, straight, short, strong; feet medium size ..	5	.....	.....
Body—			
Chest, deep, broad, large girth	8	.....	.....
Sides, deep, lengthy, closely ribbed	8	.....	.....
Back, straight, broad, thickly and evenly fleshed	4	.....	.....
Loins, wide, thick	3	.....	.....
Belly, straight	2	.....	.....
Flank, even with underline	2	.....	.....
Hindquarters—			
Hips, wide apart, smooth	3	.....	.....
Rump, long, wide, evenly fleshed, straight	3	.....	.....
Hams, heavily fleshed, deep, wide	8	.....	.....
Thigh, fleshed close to hocks	4	.....	.....
Legs, straight, short, strong; feet medium size	5	.....	.....
Total	100	.....	.....

Animal ..... Date .....
Student ..... Standing .....

(After John A. Craig.)

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Statement of Student in Competitive Judging.

Name ..... Date .....

Judging ..... Class ..... Section .....

Animal Awarded First Position	Reasons .....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Animal Awarded Second Position	Reasons .....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

Animal Awarded Third Position	Reasons .....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....
.....	.....

(After John A. Craig.)

A careful study of the scale of points for any given class of stock will convince any reasonable person that the features most likely to prove deficient are given the greater consideration. Ears, for example, upon the light horse card are given a single point, while the front feet and hock joints are allotted eight points each. Ears are important, as it is necessary for a horse to have hearing if it is to be useful, but horse ears seldom wear out in use, while sore front feet and lame hock joints probably incapacitate more horses for service than any other two points which can be named. If that is true, strong front feet and good hock joints are more important in selecting a horse than good ears. If the scale of points submitted is not right it will be possible to make one which is, as there must be a right proportionate degree of importance between the various points to be considered in selecting animals. The live stock score cards submitted herewith are mere outlines which Dean John A. Craig of the Texas Agricultural College devised, and they are only meant for the guidance of persons who have already gained a knowledge of breeds, types and market classes from some other source of information. The live stock score cards in use at this institution are printed on light card board and are four and one-half by nine and one-half inches in extent, while the cards used for competitive or ring judging are four and three-quarters by ten and one-half inches in extent.

GRAIN SCORE CARDS.

Frequent requests for the various score cards used in the grain judging work of the college classes indicate an interest in that feature of the work, and has made it seem advisable to include a list of them in this publication. The scale of points for each class of grain is printed upon a light card board three and a half by six and a half inches in extent, in the form submitted herewith. The author does not anticipate that these forms are perfect or above criticism and will be surprised if they are not revised and improved as time passes. The following is the list of grain score cards now in use:

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 7—Field Corn.

Scale of Points	Number of Exhibit				
	1	2	3	4	5
1. Earliness; cob ripe, kernel hard, plump, bright, colored 20					
2. Type; uniform and true to variety characteristics 10					
3. Shape of Ear; slightly tapering, nearly cylindrical, true to type 10					
4. Color; conforming to variety (a) kernel, (b) cob 5					
5. Tips; not too tapering, well covered, kernels uniform 5					
6. Butts; neither open nor swelled, shank small 5					
7. Kernels; true to type, not tapering, rows straight 10					
8. Length of Ear; medium for variety 10					
9. Thickness of Ear; corresponding to variety 5					
10. Rows Close; furrows in cob and space between kernels objectionable 10					
11. Proportion of Corn to Cob; eighty-five per cent 10					
Total 100					

Variety judged ....

Name of studnet ....

Date ....

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 8—Wheat.

Scale of Points	Number of Exhibit				
	1	2	3	4	5
1. UNIFORMITY; even in size, similar in shape 10					
2. COLOR; clear, bright, uniform, corresponding to variety type 10					
3. BRAN; bright, smooth, free from cracks, streaks and bleaching 10					
4. SIZE AND PLUMPNESS OF KERNELS; long, thick, heavy ...25					
5. WEIGHT; standard 60 lbs. per bushel 10					
6. DOCKAGE—PER CENT AND NATURE weight and kinds of dirt, weed seeds and very small wheat kernels 15					
7. PER CENT AND KINDS OF DAMAGED KERNELS; broken, smutty, musty or bin-burned 20					
TOTAL 100					

Variety judged ....

Name of student ....

Date ....

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 9—Oats.

Scale of Points	Number of Exhibit				
	1	2	3	4	5
1. UNIFORMITY; even in size, similar in shape 10					
2. COLOR; bright, uniform, corresponding to variety type, free from weather stains 15					
3. SIZE AND PLUMPNESS; long thick plump, corresponding in size and shape 15					
4. WEIGHT; standard 32 pounds per bushel 10					
5. FEEDING QUALITY; percentage of husk to kernel, of empty husks, of pin oats 20					
6. DOCKAGE—PER CENT AND NATURE; weight and kinds of dirt, weed seeds and foreign grain 15					
7. PER CENT AND KINDS OF DAMAGED KERNELS; musty, moldy, bin-burned 15					
TOTAL 100					

Variety judged .....

Name of student .....

Date .....

NORTH DAKOTA AGRICULTURAL COLLEGE

DEPARTMENT OF AGRICULTURE.

Student's Score Card No. 10—Barley.

Scale of points	Number of Exhibit				
	1	2	3	4	5
1. UNIFORMITY; even in size, similar in shape 15					
2. COLOR; bright, free from stains and weathering 30					
3. SIZE AND PLUMPNESS; long, thick, plump, corresponding to variety in size and shape 15					
4. WEIGHT; standard 48 pounds per bushel 15					
5. PER CENT AND KIND OF DAMAGED KERNELS; musty, moldy or bin-burned 15					
6. DOCKAGE—PER CENT AND NATURE; dirt, weed seeds and foreign grain 10					
TOTAL 100					

Variety judged .....

Name of student .....

Date .....

The above cards serve as a means of directing the attention of the students to the important things which should be taken into consideration in deciding upon the rating which should be given to the different samples of grain under inspection.

The class work given before the score card exercises are taken up familiarizes the scorer with variety and market peculiarities.

ACKNOWLEDGEMENTS.

I wish hereby to acknowledge the assistance which I have received in the preparation of this report and in carrying out the details of the trials which are described in its pages.

The aid of Mr. O. O. Churchill, assistant in plant breeding, is accredited in the body of the report and therefore requires no comment.

Mr. E. G. Schollander, who resigned the position of assistant in plant breeding on June 1, 1904, should be credited with the supervision of the plant breeding and variety work of the department prior to that date. He has also given efficient and courteous aid at various times in the preparation of this report. He has also given special aid to this department in his work upon the farmers' institute platform.

Mr. J. C. McDowell, assistant agriculturist of the station, has rendered efficient aid in the preparation of this report and in such details of the work of the department during the season as his teaching and general duties would permit. He rendered efficient aid in the preparation of the score cards for grain, copies of which are submitted in the body of this report. He has carried on some interesting soil studies which a shortage of time has not permitted him to prepare for presentation in this report.

Mr. Nicholaus Grest, foreman of the college farm, has relieved me of many of the details of the work of the department and deserves commendation for the workmanlike order in which he has performed his duties.

Respectfully submitted,
J. H. SHEPPERD,
Agriculturist.

THE EDGELEY SUB-EXPERIMENT STATION

To Director J. H. Worst:

SIR: During the past year the work at the Edgeley sub-station has been mainly a continuation of the experiments inaugurated in 1903. The data obtained in 1903, while of minor value as experimental work, has given a better insight into the kinds of trials with grain, forage crops, tree planting, etc., which need prominent attention in the future.

During the past season much time was spent in thoroughly systematizing the work and in introducing series of experiments that will be in keeping with the climatic and soil conditions prevalent in the Edgeley district.

The foul condtion of the land has seriously interfered with many of the trials of small grain and forage crops. It has been necessary to introduce a system of cropping which would correct the results of past errors in the management of the land, and to prepare for the accurate experiments to follow.

The season of 1904 proved a remarkable one for demonstrating the value of certain strains of grain as being more rust resistant than others. Different tillage methods and systems of cropping in the substation trials also proved important factors in determining the extent to which grain was damaged by rust. Land which produced a heavy growth of straw proved especially favorable to the ravages of rust.

REPORT OF GENERAL FARM WORK.

It is the plan of the sub-station to grow enough grain and forage crops to supply the needs of the live stock kept upon the farm. Fifteen acres of oats grown upon corn ground gave a yield of 70 bushels per acre, 15 acres of brome grass, sown in 1903, was allowed to ripen for seed. The grass was harvested with a binder and threshed. The straw was of excellent quality and stock preferred it to a good quality of wild prairie hay. Twelve acres was planted to golden dent corn on May 20th, but owing to the unfavorable season a very poor stand resulted and the yield of fodder was small. Many of the stalks of this corn failed to form ears. At the time of killing frost the corn was very immature.

Prior to the season of 1904 only ninety acres of the farm was under cultivation, the remaining portion being raw prairie land.

Thirty-five acres of the latter was broken during the last part of June, 1904.

IMPROVEMENTS.

To supply the urgent needs of the station, two more rooms were added to the office building, in order that it might serve as a temporary farm house until such time as a more commodious building can be erected for that purpose. A shed sixteen by fifty feet was added to the barn to provide shelter for the farm machinery used by the station.

GOVERNMENT AID.

An annual appropriation is now being received from the department of agriculture, Washington, D. C., for the purpose of breeding, introducing and distributing new and promising strains of field crops. The additional funds will make it possible to support a plant nursery for the improvement of cereals by breeding and selection. Nineteen thousand five hundred plants were grown in the plant nursery in 1904, which include the following stocks: Barley, oats, wheat, flax, millet and buckwheat. Special attention will be given in future experiments to the selection of durum or macaroni stocks and to other grain and forage plants showing marked drouth resisting qualities.

The damage caused by rust during the season of 1904 seriously interfered with the plant nursery work for the season. Many of the centgeners of fife and blue stem wheat were rendered entirely worthless by rust.

The selective effect of the rust may be of great value as a means of identifying the more vigorous plants. The following data gives the kind and number of plants grown in the plant nursery in 1904:

Barley, five stocks	3,000 plants
Macaroni wheat, eight stocks	4,000 plants
Fife wheat, ten stocks	3,000 plants
Blue stem wheat, ten stocks	3,000 plants
Flax for fiber, four stocks	400 plants
Flax for seed, six stocks	600 plants
Buckwheat, five stocks	500 plants
Millet, twelve stocks	2,000 plants
Oats, seven stocks	3,000 plants
Total	19,500

VARIETIES OF WHEAT.

Fourteen varieties of wheat were grown in the trial of 1904. These include six varieties of durum or macaroni, four of fife and four of blue stem. A one-tenth-acre plot was sown to each of the above varieties. The land used in the trial grew a crop of corn in 1903, and was prepared for the wheat trial by double discing, sub-

surface packing and double harrowing before the grain was sown. On April 30th the grain was sown with a Van Brunt single disc drill regulated to sow five pecks of seed per acre of the fife and blue stem, and slightly more than six pecks per acre for the durum or macaroni varieties. All of the grain was given the formaldehyde treatment for smut. On May 10th the young wheat plants were showing on all of the plots and made a vigorous thrifty appearance. The stand was exceptionally good as the early part of the season at Edgeley was very favorable to the heavy stooling of grain. Later in the season, most of the grain was so badly affected by rust that it filled too poorly to have more than feeding value. In some instances the rust entirely covered the stems of the plants rendering them black in appearance. But little difference was noted in the rust resisting power of the different strains of fife and blue stem respectively as all of them were badly affected. The blue stem was damaged more by rust than the fife. With the durum or macaroni wheat, the results were decidedly different. The velvet don, aronautka and gharnovka strains stand out very prominently and are much superior to the other strains of wheat in the trial in their power to resist the attacks of rust. The difference in yield of the varieties of durum or macaroni is chiefly due to the effects of rust. Table I. gives the yield and other data recorded for the different varieties of wheat in 1904.

TABLE I—VARIETIES OF WHEAT

Variety	Class	Where From	Days Maturing	Length of Stem—In.	Bearded, Smooth or Velvety	Length of Head—In.	Weight Per Bushel—Lbs.	Yield of Grain Per Acre—Bu.	Yield of Straw Per Acre—Lbs.
Pererodka	Macaroni	North Dakota Experiment Station	103	36	Bearded	2½	50	25.0	4,162
Kubanka	Macaroni	North Dakota Experiment Station	103	36	Bearded	2½	48	21.5	4,475
Velvet Don	Macaroni	North Dakota Experiment Station	103	36	Bearded	2½	57	35.2	4,530
Nicaraugua	Macaroni	North Dakota Experiment Station	103	39	Bearded	3¼	42	11.2	4,769
Aronautka	Macaroni	North Dakota Experiment Station	103	36	Bearded	2¾	56	31.3	4,541
Gharnovka	Macaroni	North Dakota Experiment Station	103	40	Bearded	2¾	55	30.8	4,410
Selected Powers'	Fife	North Dakota Experiment Station	108	42	Smooth	3¾	46	13.9	3,562
Selected 66	Fife	North Dakota Experiment Station	108	42	Smooth	3¾	42	13.9	3,626
Selected Minnesota 163	Fife	North Dakota Experiment Station	108	42	Smooth	3¾	42	11.6	3,452
Selected Rystings	Fife	North Dakota Experiment Station	108	42	Smooth	3¾	42	11.6	3,713
Haynes' Pedigree	Blue Stem.	North Dakota Experiment Station	114	42	Velvety	4	39	11.6	4,094
Bolton's	Blue Stem.	North Dakota Experiment Station	114	42	Velvety	3¾	39	11.2	4,497
Haynes' Minnesota 51	Blue Stem.	North Dakota Experiment Station	114	42	Velvety	3¾	39	11.9	3,637
American	Blue Stem.	North Dakota Experiment Station	114	42	Velvety	3¾	41	13.9	4,279
Chulbidai		U. S. Department of Agriculture	*..						

* Failure.

In computing the yields of grain sixty pounds was used as the standard bushel.

VARIETIES OF BARLEY AND EMMER OR SPELT.

Nine varieties of barley, two of emmer and one of einkorn were sown on April 30, 1904. The mariout, beldi and telli strains of barley and einkorn were received from the United States department of agriculture and all other varieties were obtained from the central station at Fargo. The varieties of barley received from the government seemed weak in germinating power, as only a fair stand was obtained. McEwan's hulless and the two-rowed mansury were less affected by rust than the other varieties of barley in the trial, but they produced a softer straw and showed a tendency to lodge. The emmer and einkorn seemed practically immune to the ravages of rust. All of the above varieties of grain were sown with a single disc drill regulated to sow eight pecks of barley, ten pecks of emmer and six pecks of einkorn per acre. The ground was prepared the same as that already described for the wheat trial. Table 2 gives the yield and other data recorded for the varieties of barley, emmer and einkorn.

TABLE II—VARIETIES OF BARLEY AND EMMER

Variety	Where From	Days Maturing	Length of Straw—In.	Length of Head—in.	No. Rows Per Head	Length of Beard—In.	Size of Berry	Color of Berry	Weight Per Bushel—Pounds	Yield of Grain Per Acre—Bu.
Six-rowed Mansury	North Dakota Experiment Station	88	34	2¾	6	3	Medium	Yellow	44	40.3
Great Beardless	North Dakota Experiment Station	88	36	3	6	...	Medium small	Yellow	38	36.5
McEwan's Hulless	North Dakota Experiment Station	88	26	2¾	2	4½	Very large	Brown	56	42.1
Manschuri	North Dakota Experiment Station	88	36	2¾	6	3½	Medium	Yellow	42	49.9
Two-rowed Mansury	North Dakota Experiment Station	95	30	2½	2	4	Very large	Yellow	48	58.8
Success	North Dakota Experiment Station	95	28	3½	2	5	Medium	Yellow	42	60.1
Mariont	U. S. Department of Agriculture	88	26	1¾	..	3½	Medium	Yellow	42	44.0
Beldi	U. S. Department of Agriculture	86	24	1¾	..	3½	Medium small	Yellow	40	43.5
Telli	U. S Department of Agriculture	104	30	2½	..	4	Small	Yellow	34	28.8
Washington Emmer	North Dakota Experiment Station	104	32	2¾	..	3½	.....	Yel. white	38	65.3
North Dakota Emmer	North Dakota Experiment Station	104	34	2½	..	3½	.....	Yel. white	38	67.9
Einkorn*	U. S. Department of Agriculture	115	30	2¾	..	3	.....	Yellow	22	56.6

* Twenty-five pounds was used as the standard in computing the yield of einkorn.

VARIETIES OF OATS.

Nine varieties of oats were grown in the trial of 1904. All of the varieties, with two exceptions, were obtained from the central station at Fargo. The red Algerian and the burt oat were received from the United States department of agriculture. The two varieties received from the United States department of agriculture made a very poor showing, as the stand, general appearance, quality and yield were all poor. The poor stand was evidently due to the poor germinating power in the seed. A Van Brunt single disc drill regulated to sow oats at the rate of two bushels per acre was used for seeding the varieties of oats. All of the varieties of oats were sown on April 30th upon land that received the same preparatory treatment and which was similar in every respect as that described for the varieties of wheat. While the rust attack was plainly visible, it seemed to be confined chiefly to the blades of the grain and in consequence the damage was not so great as it was in the wheat where the stems of the plants were also affected. The whorled or branching strains of oats were more seriously affected by rust than the side oats, the latter being practically free from rust both in the stem and leaf. Table 3 gives the yield and other data recorded for the varieties of oats.

TABLE III—VARIETIES OF OATS

Variety	Where From	Length of Straw—In.	Form of Head	Length of Head—In.	Color of Berry	Shape of Berry	Size of Berry	Weight Per Bushel—Pounds	Yield Per Acre—Bushels
Swedish Select	Edgeley Experiment Station	36	Whorled.	7	White	Short plump	Large	36	79.2
Silver Mine	N. D. Experiment Station	36	Whorled.	7	White	Medium long plump	Medium	34	85.7
Abundance	N. D. Experiment Station	42	Whorled.	8	White	Long plump	Medium large.	32	79.2
Siberian White	N. D. Experiment Station	42	Whorled.	8	White	Long	Medium large.	32	80.6
Minnesota 202	N. D. Experiment Station	39	Whorled.	8	Light yellow	Medium long	Medium	33	74.8
Select Tartarian	N. D. Experiment Station	42	Side	8	White	Medium long	Medium	36	75.5
White Russian	N. D. Experiment Station	40	Side	8	White	Medium long	Medium large.	33	72.8
Burt Oat	U. S. Dept. of Agriculture	30	Whorled.	5	Yellow	Medium	Medium small.	32	27.5
Red Algerian	U. S. Dept. of Agriculture	30	Whorled.	5	Red	Slender and long	Long	24	38.7

VARIETIES OF FLAX.

Table 4 gives the data and yield of the varieties of flax grown in the trial for 1904. A single disc drill set to sow one-half bushel of flax per acre was used in sowing the seed. An excellent stand of flax was obtained from using this amount of seed. The land upon which the trial was made grew a crop of corn in 1903 and received the same preparation as that which was used in the variety wheat trial already described. The flax was treated with formaldehyde to prevent flax wilt. No wilt was present in the flax during the growing season.

TABLE IV—VARIETIES OF FLAX

Variety	Where From	Class	Date Sown	Seed Sown Per Acre —Pecks	Length of Straw—Inches	Weight Per Bushel —Pounds	Yield Per Acre—Bushels	Weight of Straw Per Acre—Lbs.
Siberian.....	N. D. Exp. Station....	Seed.	May 13.	2	24	52	21.5	2,541
Selected Russian.	N. D. Exp. Station....	Seed.	May 13.	2	24	52	22.5	2,541
Russian	N. D. Exp. Station....	Fiber	May 13.	2	32	48	12.1	2,918
Selected Riga....	N. D. Exp. Station...	Fiber	May 13.	2	32	50	14.0	3,584

VARIETIES OF CORN.

Ten varieties of corn were planted on May 18, 1904. A hand planter regulated to drop from three to five kernels in a hill was used. The corn was planted in rows forty-four inches apart and the hills were three feet apart in the row.

The season of 1904 proved to be very adverse to the growth of corn, many of the strains being very immature at the time killing frost occurred. All of the varieties produced a very leafy and excellent grade of fodder. Owing to their habit of placing the ears close to the ground, considerable difficulty was experienced in harvesting the flint strains with a corn binder. Where the production of fodder is the chief feature desired it would seem advisable to plant the larger and taller strains, as they are more easily handled by machinery. As so few ears were formed the entire corn plant was considered field cured fodder in computing yields.

Table 5 gives the data and names of varieties of corn grown in the trial of 1904.

TABLE V--VARIETIES OF CORN

Variety	Class	Where From	Stand	Stage of Maturity at Killing Frost	Height of Stalk—Ft.	Field Cured Fodder Per Acre—Lbs.
Golden Dent	Dent	Magill & Co., Fargo, N. D.	95	Milk to glaze	4½	1,713
Triumph	Dent	Magill & Co., Fargo, N. D.	95	Kernels just forming	5	3,512
Mercer	Flint	Magill & Co., Fargo, N. D.	90	Milk to glaze	4	2,787
Northwestern Dent	Dent	Magill & Co., Fargo, N. D.	90	Milk to glaze	4	2,787
Yellow Fodder	Dent	Magill & Co., Fargo, N. D.	85	Few nubbins	5	2,991
Station No. 100	Dent	Magill & Co., Fargo, N. D.	90	Milk to glaze	4	2,448
White Flint	Flint	Magill & Co., Fargo, N. D.	95	Milk to hard	3½	2,904
Minnesota Dent No. 13	Dent	Magill & Co., Fargo, N. D.	95	Very immature	5½	3,630
Pride of the North	Dent	Magill & Co., Fargo, N. D.	95	Kernels just forming	5½	3,281
Gehu	Flint	Magill & Co, Fargo, N. D.	85	Milk to hard	3	1,277

VARIETIES OF POTATOES.

On May 21st fifteen varieties of potatoes were planted on land which grew a crop of millet in 1903. The tubers were cut in such a manner as to leave from two to four eyes in a piece. The potatoes were dropped by hand, two pieces being planted in each hill. The rows were placed three and one-half feet apart and the hills at three foot intervals in the row. The potatoes were slow in coming up and their subsequent growth was considerably retarded by cold damp weather. All of the varieties of potatoes in the trial made a poor stand, and at a later period of growth were badly injured by dry weather and late blight. Twelve hills of each strain was harvested in order to get comparison of their yields and to obtain seed for the crop of 1905.

Table 6 gives the data for the varieties of potatoes grown in the trial of 1904.

TABLE VI—VARIETIES

Variety	Where From	No. Hills Harvested	Average Size of Tubers
Hammond's Wonderful	N. D. Experiment Station	12	Medium small
Astonisher	N. D. Experiment Station	12	Medium large
All the Year Round	N. D. Experiment Station	12	Medium small
Daughter of Rose	N. D. Experiment Station	12	Medium small
Quick Crop	N. D. Experiment Station	12	Medium large
Maule's Commercial	N. D. Experiment Station	12	Medium large
Earliest Six Weeks	N. D. Experiment Station	12	Medium small
Early Minnesota	N. D. Experiment Station	12	Medium large
Early Ohio	N. D. Experiment Station	12	Medium small
Rose of the North	N. D. Experiment Station	12	Large
Banner	N. D. Experiment Station	12	Large
May's Netted Gem	N. D. Experiment Station	12	Medium large
Early Harvest	N. D. Experiment Station	12	Medium large
Early Rose	N. D. Experiment Station	12	Large
Main Crop	N. D. Experiment Station	12	Medium large

* Slightly affected with dry rot.

OF POTATOES

Shape	Color	Depth of Eyes	Fingers and Toes—Per Cent	Marketable—Per Cent	Small—Per Cent	Scabby—Per Cent	Yield of 12 Hills—Pounds
Long oblong.....	Russet.....	Shallow.....	None	48	52	None	20
Long oblong.....	Light red russet	Medium.....	None	45	55	None	13
Oblong.....	Red russet	Medium.....	None	64	37	5	12½
Long oblong.....	Rose red russet.	Medium deep...	None	44	56	None	15
Long oblong.....	White.....	Medium deep...	None	45	55	None	17½
Oblong.....	Red.....	Deep	None	77	23	None	18*
Oval oblong.....	Red russet	Medium.....	None	63	37	None	19
Oblong.....	Red russet	Medium.....	None	43	57	3	16½
Oblong.....	Red russet	Medium.....	2	45	55	None	18
Long oblong.....	Rose red russet.	Medium.....	7	71	29	None	15½
Flat oval.....	White.....	Medium shallow	None	80	20	None	20
Medium long.....	Deep russet.....	Shallow.....	3	50	50	None	17
Long oblong.....	White.....	Medium deep....	None	50	50	None	12*
Long oblong.....	Rose red russet.	Medium..... ..	11	50	50	14	19
.....	.....	.....	1	46	54	None	18

VARIETIES OF MILLET.

The weather conditions of the past season have been very unfavorable to the growth of millet. Some of the strains were practically a failure. As a result of the slow growth of millet during the early part of the season, weeds sprang up and made such rapid headway as to seriously damage the crops. Owing to the ragged and weedy appearance of the millet, it was cut for hay on August 24th.

Table 7 gives the yields and other data recorded for the different varieties in the trial.

TAELE VII—VARIETIES OF MILLET

Variety	Where From	Date of Sowing	Rate of Sowing Per Acre—Bu.	Stand—Per Cent	Date Harvested	Yield Hay Per Acre —Pounds
Pencilaria	Magill & Co., Fargo, N. D.	May 19	½	..	.....	Failure
Siberian	Mag ll & Co., Fargo, N. D.	May 19	½	80	Aug. 24	4,150
German	Magill & Co., Fargo, N. D.	May 19	½	75	Aug. 24	4,200
Japanese	Magill & Co., Fargo, N. D.	May 19	½	..	.....	Failure
Hog	Magill & Co., Fargo, N. D.	May 19	½	80	Aug. 24	4,500
Early Fortune	Magill & Co., Fargo, N. D.	May 19	½	60	Aug. 24	3,550
Red Orenburg	U. S Dept. of Agriculture.	May 19	½	80	Aug. 24	4,660
Black Veronezh	U. S. Dept. of Agriculture.	May 19	½	80	Aug. 24	4,575
Red Veronezh	U. S. Dept. of Agriculture.	May 19	½	80	Aug. 24	4,365
Brome Corn Millet	U. S. Dept. of Agriculture.	May 25	½	75	Aug. 24	4,435

CROP ROTATION.

A close study of the soil moisture problems of this district has led to the conclusion that short rather than long systems of crop rotation will prove of greater value. Twenty-five different methods of cropping were introduced in 1904. Each system listed below describes a complete rotation upon the particular plan which it is to follow, and each one is to be carried on for a series of years.

No. 1—Wheat one year, potatoes one year.
No. 2—Wheat one year, oats one year.
No. 3—Wheat one year, flax one year.
No. 4—Wheat one year, corn one year.
No. 5—Wheat one year, emmer one year.
No. 6—Wheat one year, fallow one year.
No. 7—Wheat one year, barley one year.
No. 8—Wheat two years, corn one year.
No. 9—Wheat two years, corn one year.
No. 10—Wheat two years, corn one year.
No. 11—Wheat two years, meadow two years, corn one year.
No. 12—Wheat continuously, fall plowed land.

No. 13—Flax continuously, fall plowed land.
No. 14—Wheat continuously, spring plowed land.
No. 15—Wheat continuously, spring disced land.
No. 16—Wheat one year, millet one year.
No. 17—Wheat one year, millet one year.
No. 18—Wheat one year, corn planted thick one year.
No. 19—Wheat one year, corn planted medium thick one year.
No. 20—Wheat two years, fallow one year.
No. 22—Wheat one year, flax one year, fallow one year.
No. 23—Wheat two years, green manured one year.
No. 24—Wheat one year, corn one year, flax one year.
No. 25—Wheat one year, corn one year, flax one year.

NOTE—No. 8 is plowed four inches deep and receives ten loads of well-rotted manure before the corn is planted. No. 9 receives the same treatment with the exception that it is plowed seven instead of four inches deep. No. 15 is to be fall plowed one year and spring disced the next. No. 16 is fall plowed each season after the wheat and millet crops respectively. No. 17 is plowed after wheat and spring disced after millet. On No. 23 the peas are turned under as a green manure crop. No. 24 is plowed four inches deep each season. No. 25 is plowed seven inches deep for comparison with the four-inch plowing on number 24. It will be noticed that in this trial wheat follows nearly all of the cultivated and cereal crops grown in North Dakota.

TREES AND HEDGES.

Forest Tress.—A number of forest and ornamental trees were set out in 1904. These include ash, boxelder, elm, North Carolina poplar and hackberry. Two-year-old seedlings of elm, ash, boxelder and soft maple, planted in 1903, partially winter killed in the upper portion of the branches during the very unfavorable winter of 1903-4. The soft maple trees killed out entirely in many instances. The elm, ash and boxelder have proven about equal in hardiness.

Fruit Trees.—With but two exceptions, all varieties of fruit trees planted in 1903 proved hardy. The Duchess and Haas apple trees winter killed badly in the upper branches.

Two hundred trees of the common native plum were added to the fruit garden during the past season.

Hedges.—The Golden Russian willow and wild olive are now being given a trial to determine their respective values as shelter belt hedge plants. The Golden Russian willow has outgrown the wild olive, and will evidently supply protection much sooner than the latter. A Golden willow hedge set out in 1902 is now six feet high, one planted in 1903 has made a growth of four feet and another planted in 1904 made a growth of three feet the first season.

FORAGE CROPS.

Brome Grass.—The trials made with brome grass have shown that it is a valuable grass for either hay or pasture in the drier portions of the state. A good stand has been obtained both with and without a nurse crop, although when a nurse crop was not used the plants were stronger and more vigorous in appearance.

Corn and Millet.—The past season has been very unfavorable to the growth of these valuable forage crops. The limited trials conducted at the sub-station show them to be profitable for fodder production and excellent preparatory crops for small grains to follow.

Alfalfa.—So far alfalfa has not proven a success as a hay crop. A fairly good stand of alfalfa has been obtained, but many of the plants were small, sickly and yellow in appearance. The plants having a healthy appearance were plentifully supplied with the root tubercles common to the leguminous class of plants, while those which were yellow in color had no tubercles. Trials are now in progress to determine the effect of inoculating the soil with dirt taken from an old alfalfa field where the bacteria producing the root tubercles were abundant.

OTHER TRIALS.

The sub-surface packing and fertilizer trials with wheat were rendered worthless by rust. The yields were more completely controlled by the rust than they were by the special treatments which were to constitute the trial.

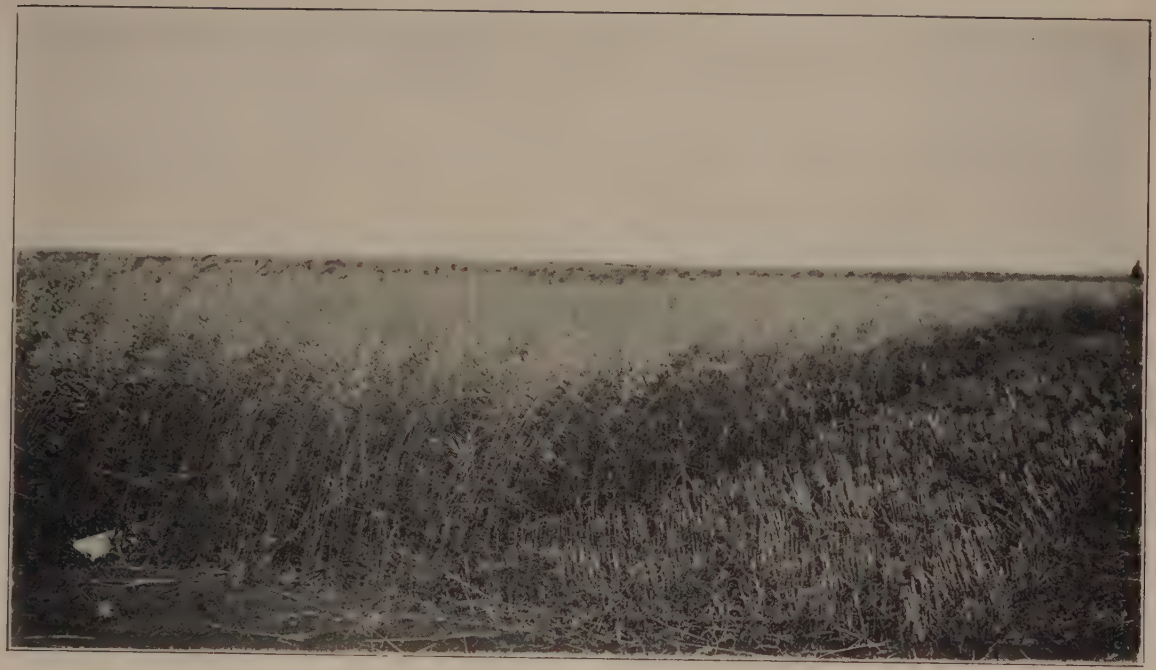
C. B. Waldron, Horticulturist of the Central Experiment Station, has had general supervision of all tree and hedge planting on the sub-station grounds. He has selected the varieties and recommended the sites and gave the plan of culture to be followed.

Respectfully submitted,

O. A. THOMPSON,
Superintendent.

J. H. SHEPPERD,
Vice Director.

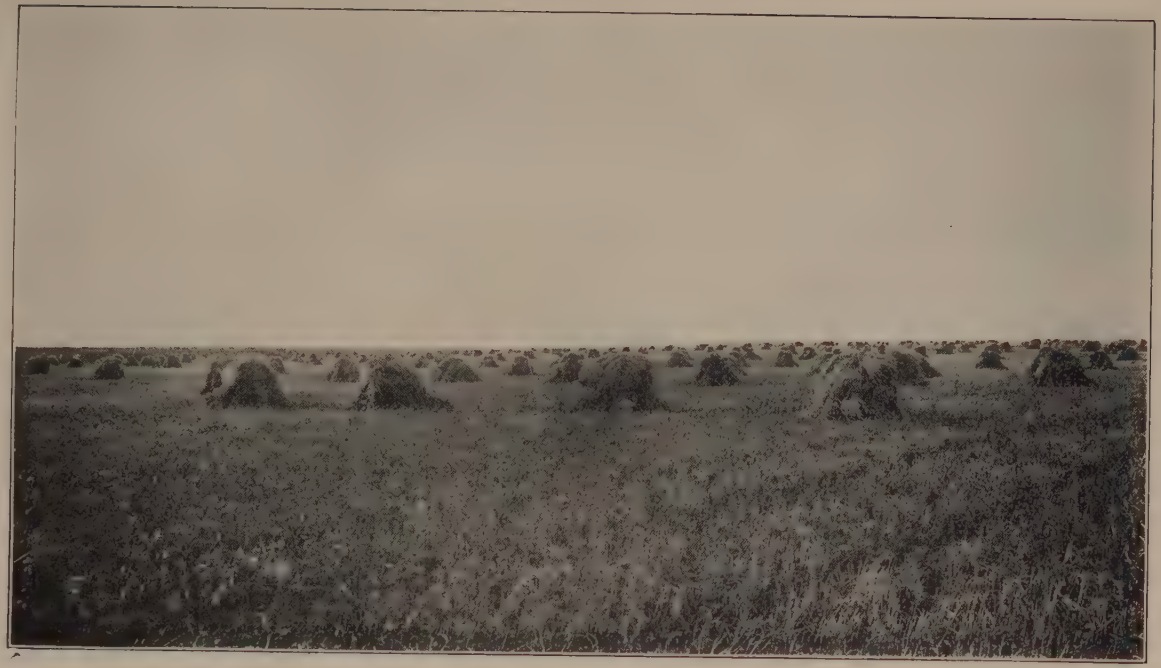
Orchard at Edgeley Sub-Station in 1904. This orchard was set out in the spring of 1903.



Variety trials with oats at the Edgeley Sub-Station in 1901. The Swedish select strain is in the foreground.

Abundance oats grown at the Edgeley Sub-Station in 1904.

Harvesting a field of oats at the Edgeley Sub-Station in 1904.



View in a grain field at the Edgeley Sub-Station, autumn of 1904.

View of the Edgeley Sub-Station field trial grounds. Varieties of millet in the foreground.

POULTRY REPORT FOR 1904

NUMBER OF EGGS LAID.

January	464
February	406
March	331
April	1,067
May	1,304
June	913
July	520
August	803
September	701
October	164
November	39
December	50
Total	6,762

Or 563½ dozen.

EGGS SUPPLIED TO FARM HOUSE.

Month	No. Dozen	Price Per Dozen	Value
January	28	.30	$ 8.40
February	29	.30	8.70
March	26½	.30	7.95
April	71	.18	12.78
May	61	.15	9.15
June	61½	.12½	7.69
July	36½	.12	4.38
August	63	.12	7.56
September	48½	.12	5.82
October	24½	.15	3.67
November	10½	.20	2.10
December	4½	.25	1.12
Total	464½		$79.32

Average number of hens during the year, seventy.

Sold to outside parties twenty-four and one-half dozen at an average price of 24½ cents, which amounted to $6.

Sold to the domestic science department of the college fourteen dozen at 16 cents, which amounted to $2.24.

Account with J. Haggart (replaced) five settings or sixty-one eggs which amounted to $5. Seven settings or 104 eggs at $1 per setting, $7. These latter items amount to $20.24.

HATCHING.

Eggs set	553.	
Eggs broken in nests	28	
Eggs not fertile	156	
Total number of fertile eggs	369	or 66½ per cent
Total number hatched	294	or 80 per cent
Total number of chicks raised	110	or 37 per cent
191 pounds of poultry killed for farm house .15		$28.65
Four cockerels sold February 9 at $1		4.00
Number of casualties from disease, accidents, etc., among old fowls during the year	19	
Deaths among young Plymouth Rocks due to salt poisoning	12	

Number of fowls destroyed in fire as based on an inventory taken October 15:

12 Brown Leghorn chicks (five cockrels and seven pullets).
22 Barred Rock chicks (eleven cockerels and eleven pullets).
4 Brown Leghorn hens.
7 Barred Rock hens.

45 Total.

INVENTORY OF PRESENT STOCK.

Kind of Bird	Leghorn	Rock	B. Leghorn	Total
Pullets	16	23	5	44
Hens	18	19	..	37
Cockerels	1	4	..	5
Cocks	1	1	..	2
Total	..	..	..	88

SUMMARY.

Eggs to farm house	$ 79.32
Eggs to outside parties	6.00
Domestic science department	2.24
John Haggart	5.00
Settings sold	7.00
Cockerels sold	4.00
Poultry for table	28.65
Total	$132.21

HORTICULTURAL DEPARTMENT

To President J. H. Worst:

SIR: A record of the work done in the horticultural department for the past year includes the following features:

1. Variety and cultural tests with vegetables.
2. Improvement of vegetables through seed selection.
3. Experiments in the cultivation of small fruits.
4. Improvement of the native plum through selection.
5. Additional work in tree culture.
6. Further work over the state in connection with the hessian fly.

There is no demand in this state for extensive trials of any kind in the line of vegetable culture. The industry of market gardening is very restricted both as to output and variety of vegetables. A few people in the vicinity of the larger towns are furnishing such supplies as are needed, chiefly in the line of celery, cabbage, onions and the early summer vegetables. There is no tendency to grow truck in quantity for distant markets and will not be while the land is cheap and sparsely settled and while general farming brings such good returns.

The inquiries concerning vegetable culture come mostly from farmers wishing to learn of the varieties of the different vegetables best suited for them, and the best methods of growing them in the home garden. As the question of revenue is not involved to any extent, the relative money making capacity of the different varieties is of little importance. A sweet corn for instance that is early and of good quality meets all their requirements, even though it might not be the most profitable sort to grow in a large way for canning. The same is true of the other vegetables. For this reason our vegetable trials have been confined to varieties of which we are reasonably certain as to quality and general fitness for the home garden.

The methods of cultivation are also for the most part such as the farmer would be likely to find practical from his standpoint. Keeping these points in mind it has been the aim to have as good a garden as possible, as a demonstration of what can and should be done on every farm. The fact that our beets, onions, cabbage and celery all successfully competed with vegetables from all parts of the country at the World's Fair in St. Louis ought to be sufficient encouragement for all farmers to maintain a first class vegetable garden.

Our trials with vegetables for 1904 included ten varieties of cabbage, seven of sweet corn, six of celery, fifteen of tomatoes and the

various other garden vegetables in like proportion. The work of selection from our own strains was continued as in former years.

FRUIT CULTURE.

The winter of 1903-4 was a trying one with many kinds of fruits, showing the weakness of a number of varieties and also the necessity of proper protection in winter.

The loss of plum and apple trees was considerable at the home station. One plot of trees that was planted four and five years ago was not mulched in the fall. This plot has good protection on the north and west so mulching was not considered necessary, more especially as the trees were thrifty and of considerable size.

It is a safe rule to lay down that if there is a possibility of the ground becoming bare during the winter a liberal mulching of straw should be placed around all fruit trees to prevent root killing. With the uncertainty of snowfall in this state the rule for mulching might be considered for all practical purposes a universal one.

At Edgeley all of the fruit trees were mulched, with the result that none were killed though they had no protection in the way of windbreaks.

At the home station also all of the trees that were mulched survived, though many of them had been set out in the fall, nearly up to the time of freezing. The time of applying the mulch to trees is also important. If put on too early it induces a late fall growth of the trees that is not suited to endure severe freezing.

If however it is applied after the ground is frozen to some depth but little good is accomplished. Just before the ground begins freezing is the proper time. It should then be applied to a depth of six inches to a distance of four or five feet from the tree. Whenever mulching is used it is necessary to afford the tree some protection from mice. Our practice has been to tie a strip of tar paper about the trunk of each tree before the mulch is applied, removing it in the spring. A strip of burlap wound spirally about a trunk affords equally good protection and may be left for two or three years.

The effect of mulching upon trees is seen not only in preserving them from actual destruction but in their increased growth the following season. This was especially well illustrated in the case of some seedling trees at Edgeley set in the spring of 1903. Those that were mulched at the close of the first season made about twenty-five or thirty per cent more growth than those that were left unprotected.

The manner of planting young trees is quite as important in the matter of preventing winter-killing as is mulching. A tree that has its roots close to the surface of the soil and one that has but poor connection with the soil is not likely to endure severe winter condi-

tions. Our own experience for the last year has shown this to be of the greatest importance.

Young trees should be set considerably deeper than they grew in the nursery. A foot deeper is not too much on ordinary soils if the trees are properly planted. This will necessitate digging the holes for the trees to a depth of about two feet. If the soil at that depth is hard and compact, unsuited to the growth and development of the roots, good surface soil should be worked in about the roots and tamped in firmly as the filling progresses.

Trees thus planted immediately take a good hold of the soil and are able to endure cold and drouth that would make but short work of trees carelessly and loosely planted.

Deep planting not only insures the trees sufficient moisture, but prevents their being wrenched about by the winds thus preventing the roots from taking hold of the soil. The excellent growth of the plum and apple trees planted at Edgeley is undoubtedly due to this method of planting, while that together with the mulching, explains their ability to endure the severe winter of 1893-4.

Among the trees at the home station not mulched that suffered the most were those from which the dirt had been partially removed during the last three or four years through the effect of the wind and the washing by water during heavy rains.

It need hardly be said that without good cultivation through the summer the best of planting and mulching will not insure success.

VARIETIES.

The following varieties of apples fruited at the Fargo station last season: Berlin, Hibernal, Lyman's Prolific, Yellow Siberian and one seedling.

The Berlin is ten years old and fruited for the first time. The fruit ripened in September. It is green in color, of good size and fair quality. The tree is of compact, upright growth and so far has proved perfectly hardy and free from blight.

The Hibernal began fruiting at seven years. The fruit ripens late in the fall. It is greenish yellow, large and somewhat irregular, rather acid, juicy, excellent for cooking. This variety represents the extreme type of hardiness and is comparatively free from blight.

Lyman's Prolific is a large crab. The trees began bearing at four years and last season fruited heavily. Its location is unfavorable which may account for its not enduring the winter as well as some of the others.

The Yellow Siberian fruited very heavily. This is the small yellow crab commonly found in the markets. The trees are very hardy and do not blight badly.

PLUMS.

The De Soto was the most satisfactory variety last season. It fruited very heavily and was not injured from any cause.

The Surprise and Aitkin were both badly winter killed at the home station but came through uninjured at Edgeley.

The Wyant made about the most satisfactory growth of any of the varieties, the trees being unusually sturdy and vigorous This sort fruited at Edgeley the first year after planting.

The Odegard gave the largest fruit, but did not bear so heavily as the De Soto.

The third generation of our own seedling plums gave fruit on some of the trees equalling the De Soto in size, and perhaps excelling it in quality. One hundred of these trees were set at Edgeley and should begin bearing next season.

SMALL FRUITS.

No new varieties of currants or raspberries were planted last season and we have nothing to report upon these fruits further than was published in bulletin No. 59 issued a year ago.

The Cardinal and Colorado Iron Clad raspberries both endured last winter without protection and yielded well last season.

Considerable attention was given to strawberries and good results were obtained. Promising varieties that hitherto had been grown only in the trial bed were given an opportunity to show what they would do when grown in a larger way.

A bed of four-tenths of an acre planted to the New York, North Dakota, Sample, Warfield, Senator Dunlap, Bederwood and Wm. Belt came into bearing last year. These varieties had all shown up well in the trial bed and it was to be expected that they would make a reasonably good account of themselves anywhere. As the different varieties had been planted at different times it was impossible to establish an exact comparison between them. With the exception of the North Dakota they all yielded well. This variety seems very thrifty and may do better another season.

The Senator Dunlap is the most vigorous and thrifty of all, yields well and is of fine quality and appearance. Owing to its tendency to produce a large number of plants it requires more attention than some of the others. Between the other varieties it is hard to make a comparison. They all yielded well and no one was heard to object to the quality of the fruit. The yield of this bed was one thousand quarts. The showing made was such as to create considerable interest. Constant inquiries are coming in regarding strawberry culture and a great many demands are also being made for plants.

Last summer one acre of clover sod was plowed and in September was set to strawberries. The season was favorable and the plants made a good start. Whether fall planting is practical so far north as this remains to be seen.

Though but little fruit should be obtained from this bed next season, yet the work is done and out of the way of the rush of the spring

work. The new plants should also get an earlier start than from spring set plants, making possible a larger yield the following season. A new trial bed should be set out in the spring that many of the newer varieties about which we are receiving inquiries may be tested.

TREE PLANTING.

During the last season about one and one-half acres of seedling trees were planted as an addition to the present arboretum. These consisted of ash, elm, hackberry, soft maple, box elder and basswood. Some of them were in rather poor shape upon arrival and the percentage of loss is more than usual. These should be replaced in the spring and additional plots of four acres planted. There are still several varieties of trees that are not sufficiently represented and plantings of these should be made without further delay.

The station receives many inquiries as to whether it is practical for the farmer to grow trees for fuel and also for posts. None of our planting so far has been made with these ends in view. I would therefore recommend that means be provided for establishing plantations that shall be the basis of experiments along these lines.

A trip was made to the Bad Lands last spring to obtain some of the native Red Cedar for planting at the station. These trees are of somewhat different character than those of the same species found elsewhere. Their compact dwarf form and undoubted hardiness are qualities that should strongly recommend them for general ornamental planting. Something over a hundred small trees were secured, the greater number of which lived through the rather difficult ordeal to which they were necessarily subjected.

At the Fargo station and also at Edgeley a number of shade trees and hedges were planted about the drives and buildings for ornamental effect. There is great need for more work to be done along the same line, particularly with hardy shrubs and flowers. Owing to the absence of ornamental parks and public places within the state most of our citizens do not have the opportunity to become acquainted with the means of landscape decoration. The grounds and campus of the Agricultural College are naturally looked to by those seeking such information. A liberal expenditure made in this direction would not only be a good investment because of the instruction and inspiration it would furnish, but would greatly aid the college and station by attracting visitors. The rather meager showing already made undoubtedly does much in creating a favorable impression and brings to us yearly hundreds of visitors that otherwise would not be attracted here.

Last spring something over two hundred thousand cuttings of the Golden Russian willow were sent to farmers in different parts of the state. Reports have been coming in from time to time indicating that in the majority of cases a satisfactory stand was obtained.

INJURIOUS INSECTS.

On account of the general injury to the wheat crop in the eastern half of the state through rust it is a difficult matter to estimate the damage done by the Hessian fly, but it easily ran into the hundreds of thousands of dollars. Early in June I received samples of wheat that were badly infested with the fly, then in the flax seed stage. Owing to class work at the college I was unable to make any field investigations at that time but concluded from what is known of the habits of the insect and especially from investigations carried on by Prof. Washburn of the Minnesota station that the insect must be two brooded. This accounts for the comparatively great injury done each year in a region where the chance of its passing over the winter in considerable numbers is practically impossible. Since the only means the insect has of passing from one season to the other is in the stubble left standing until the spring is well advanced, and since this area of stubble is relatively small as nearly all the land is plowed in the fall or early spring, it has been somewhat of a question why the ordinary farming methods do not result in the practical extermination of this very injurious pest.

The fact of the existence of a spring brood makes this matter clear. This early brood allows the insect to multiply a hundred fold before it begins its attack in the summer that results in the breaking over of the straw at the time the wheat is ripening.

Prof. Washburn has found evidence of a fall brood in the volunteer wheat that comes up after harvest. Just how extensive this fall brood may prove to be is a matter of great importance and any evidence upon it would be of material value. My own observation has been that by far the greater number of the pupae remain in the stubble just as they were at harvest time and do not emerge in the adult stage till the following season.

Just what proportion come out early and deposit eggs in the very young wheat in time for the grubs that hatch to develop into the second brood that, in turn, infects the wheat while it is heading, is a question that needs to be determined. If this spring brood is the regular thing and embraces practically the entire species at that period, there is the greater necessity of using the precautionary measures that this Station has each season recommended. In order that their importance may be kept in mind it will do no harm to repeat them now.

Remedies.—When scattering straws at or just before harvest time break over just above the second joint from the ground, it indicates the presence of the Hessian fly. An examination of the stalk at this point will reveal the presence of one or more small brown bodies somewhat resembling a small flax seed situated between the sheath of the leaf and the stalk. Such grain should be cut high and the stubble burned in the fall or early spring. Where the ground is to

be plowed the burning is not necessary, but in that case the plowing should be done in such a manner as to cover well the stubble. Harrowing after plowing aids in this.

The burning or plowing should be done in the fall or if in spring before the 10th of May. All of the stubble over the infected region must be plowed or burned. Some varieties of wheat are more liable to attack than others. The durum or so-called macaroni wheat seems to be free from attack.

Prospects for Future Damage.—The fly was much less destructive in the extreme eastern part of the state than in 1903. This was due to its natural enemies or unfavorable weather conditions or both. The possibilities are that the damage will not be great in that region in 1905. Beginning back about forty miles from the Red river the condition is less favorable. From there to the James river the damage last season was considerable and unless natural causes interfere there is likely to be something of the same condition next year. I spent three weeks in this region last season at the time the damage was the most apparent, and it is to be supposed that the agitation of the subject at that time with the farmers will result in lessening the danger for this season. There is such a universal willingness on the part of the farmers to co-operate in the suppression of this pest that the enactment of a law to compel the burning or plowing of the stubble at the proper season seems hardly necessary. The willingness of the railroads to co-operate by furnishing transportation has made possible a more extended work than could otherwise be attempted.

The necessity of making personal visits to the infested regions seems absolutely necessary if much is to be accomplished. The station publications reach only a part of the farmers, and even these are not likely to give the subject serious attention till one points out the loss that they are meeting with upon their own farms.

There still remains the necessity of making further investigations in the field to acquire a more thorough knowledge of the life history of the fly.

EQUIPMENT.

As the number of students increases there is the greater necessity of providing adequate means for their instruction. With small classes, enough personal attention can be given each student to overcome in a measure lack of proper facilities. With classes of the present size this is impossible. I now have one class of sixty students taking instruction in practical horticulture and tree growing. The aim is to give them such information as they can make immediate use of, to show them how to set out and care for the different plants. The work is new to most of them and such information as may be conveyed with no other help than a blackboard is not likely to make them so skillful as would the actual performance of the

different operations with their own hands. A greenhouse for such purposes could be constructed without great cost.

Other much needed accommodations are storage rooms for plants and vegetables of which the station now has absolutely nothing. The keeping qualities of the various sorts of onions, cabbage and celery are important matters to one who grows them. The keeping over winter of half hardy plants, of bulbs and roots might also be considered a necessity.

The advantage arising from more extensive work in fruit growing as well as in the cultivation of trees and ornamental plants has already been suggested. Visitors come to the station largely to see and learn of things they do not have at home. Since fruit orchards and ornamental plants and shrubs are of the things least common with them, it follows that the station has an excellent opportunity here to make itself known to the people of the state.

Realizing our lack of funds for anything but the bare necessities I have not urged this matter in the past so insistently as I might have done or as it has well deserved.

Respectfully submitted,

C. B. WALDRON.

STATEMENT.

Of Receipts and Expenditures From July 1, 1903, to July 1, 1904.

RECEIPTS.

Received from U. S. Hatch Act March 2, 1887	$15,000.00

DISBURSEMENTS.

By salaries	$ 8,826.90
Labor	3,185.48
Publications	1,162.75
Postage and stationery	193.52
Freight and express	102.65
Heat, light, water and power	104.13
Chemical supplies	73.46
Seeds, plants and sundry supplies	172.06
Feeding stuffs	123.98
Tools, implements and machinery	84.91
Scientific apparatus	51.58
Live stock	654.18
Traveling expenses	200.00
Contingent expenses	39.00
Buildings and repairs	25.40
Total	$15,000.00

INDEX

A

PAGE

Aid, state 9
Agricultural department 67-152
Aid, government, to Edgeley sub-experiment station 154
Apples, varieties fruited at Fargo station 173

B

Board of trustees 3
Buildings, new 8
Briquettes 30
Botany, department of 33
Barley, varieties of 117, 157
Buckwheat, varieties of 126

C

Chemical department 11
Corn, analysis of stalk 31
Clover, red and bumblebees 63
Clover, red, trials 96
Corn, varieties of 126, 161
Corn, drilled, compared with corn in hills 130-134
Corn, thickness of planting in hills 132
Corn, dates of planting in drill rows 133
Corn, cultivation trial of 134
Crop rotation 166

D

Diseases, plant 9
Drilled corns compared with corn in hills 130

E

Emmer, varieties of 124, 157
Edgeley, sub-experiment station 153

F

Farmers' institutes 7
Formaldehyde, analysis of 18-26
Formaldehyde, loss of strength 26
Formaldehyde, short weight and measure 27
Formaldehyde, remedy 29

PAGE

Flax, work on 65-65
Fertilizer test with wheat 108
Flax, varieties of 122, 161
Forage crops 168
Fruit, small 174

G

Grasses and forage plants 63

H

Hedges and trees 167
Horticulture, department of 171-178

I

Insects, injurious 176

M

Millet, varieties of 126, 166

O

Oats, varieties of 111, 159

P

Plant diseases 9
Potatoes, experiments upon 54
Plant breeding 69
Potatoes, varieties of 135, 163
Peas, varieties 138
Poultry, report of 169-170
Plums 173

R

Report 7
Rainfall, records of 12
Rainfall, inches of 17
Red clover and bumblebees 63
Red clover trials 96
Rape, test of rape in wheat for fall pasture 109
Rye, varieties of winter and spring 110

S

Sunshine, per cent by months 14
Seeds, weed 56-60
Seed distribution 70
Score cards, live stock 138-146
Score cards, grain 147-151

PAGE

Sub-experiment station, Edgeley 153
Spelt, varieties 157
Small fruit 174

T

Temperatures, summaries of 12
Trees, feeding and medicating, internal 56
Trees and hedges 167
Tree planting 175

W

Water, evaporation of 15
Wheat, experiments and studies upon 34-48
Wheat, when to cut rusty 46
Wheat, rust 44
Wheat, rusted, that should not be used for seed 50
Weeds., seeds 56-60
Weeds, spraying experiment to kill 61-62
Wild oats, maturing of 63
Wheat, varieties of 97, 154
Wheat, preparation of corn stubble for 108
Wheat, test of rape in wheat for fall pasture 109